INFANT-FEEDING

IN ITS RELATION TO

HEALTH AND DISEASE

BY

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Containing 52 Illustrations, with 23 Charts and Tables, Mostly Original

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THIS BOOK

IS

DEDICATED TO MY FRIEND,

DR. GEORGE F. SHRADY,

AS A

TOKEN OF RESPECT

AND FOR HIS STERLING QUALITIES AS A MAN AND
HIS SINCERITY AS A PHYSICIAN.

PREFACE.

DURING ten years' experience in the children's service of one of the largest children's clinics in this country the author has met with many intricate problems in infant-feeding. Besides this, many points were gained while studying abroad through the wise counsel of Professor Adolf Baginsky at the Kaiser and Kaiserin Friedrich Children's Hospital in Berlin, both in his hospital wards as well as in the out-patient department.

While lecturing on diseases of children at the New York Post-graduate School and Hospital, and later while instructing at the New York School of Clinical Medicine, the author has noted the great anxiety with which his students, all of whom were physicians in active practice, requested detailed information regarding the "Modern Methods of Infant-feeding."

The author has therefore felt that if his experience, aided by the suggestions of many good text-books, were combined to give details pertaining to the feeding of infants and children requiring breast-feeding or hand-feeding,—so-called bottle-feeding,—then his work would serve as a guide to both the active practitioner and also to the beginner in medicine.

LOUIS FISCHER.

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NEW YORK CITY.

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PART I.

CHAPTER I.

Introduction.

To properly understand the difference between the various forms of infant-feeding it is necessary to consider the anatomy and physiology of the very young digestive tract.

The infantile stomach is vertical and cylindrical and the fundus but little developed. Thus, whenever there is a tendency to vomit, the antiperistaltic motions do not press against the fundus, but directly upward. There is, therefore, less genuine vomiting than a mere overflow of the gastric contents, which takes place so easily that the babies are not disturbed by it.[1]

ANATOMY.

The muscular development is weakest at the fundus. According to Fleischmann, the fibræ oblique and the longitudinal fibres described by Henle, which have their origin at the pyloric opening, "do not exist in the infant." In spite of this lack of muscular development, the investigation of Leo and von Puteren show that the gastric contents of nursing infants are propelled within from one and a half to two hours. With food that is more difficult to digest the stomach is emptied much slower and less complete.

The Mucous Membrane of the Stomach.—The mucous

[1] Jacobi, "Therapeutics of Infancy and Childhood," page 25.

glands are far more numerous on the pars pylorica than in adults, whereas they are far fewer in number at the cardia.

The mucous membrane of the infant secretes a gastric juice which, in general, is similar in properties to that of the adult. The secretion in the infant is *far less* than in the adult, but its chemical constituents are like the adult, namely: pepsin, lab-ferment, and acids. The exact proportion of a ferment and pepsin has not yet been sufficiently studied to base positive deductions therefrom.

PHYSIOLOGY.

It is very important to know that the mucous membrane of the mouth is practically dry at birth, and the secretion of saliva very small, and increases toward the end of the second month, according to Korowin and Zweifel.

The fermentative (sugar-forming) property of saliva, which is trifling at the commencement, increases with the quantity of the saliva secreted. This is essentially true of other secretions; thus, the pancreatic juice does not have the same emulsifying properties in the infant as in adults.

The nursing or sucking centre is located, according to experiments made on animals by Basch, in the medulla oblongata on the inner side of the corpus restiforme.

The sucking act is reflex; according to Auerbach, the muscles of the tongue participate most actively.

Acids in the Infant's Stomach.—The gastric contents in a nursling contain two acids: (1) hydrochloric acid; (2) lactic acid. The relative acidity is smaller than in adults, the highest point being reached one and a half hours after nursing. According to Puteren, the acidity

is 2 $^1/_2$ to 3 times as small as in the stomach of adults. According to Leo, the acidity of the gastric juice of nurslings 1 $^1/_2$ hours after drinking is only 0.13 per cent., whereas, in the adult at the same time, the acidity is from 1.5 to 3.2 per cent. According to Wohlmann, the free HCl in healthy nurslings can be found from 1 $^1/_4$ to 2 hours after taking food. The percentage of free HCl ranges from 0.83 to 1.8 per cent.

Lactic Acid.—The quantity of lactic acid is, according to Heubner, between 0.1 and 0.4 per cent.

Pepsin and Hydrochloric Acid.—There are two chief functions of the pepsin and hydrochloric acid which are the same in both infant and adult: First, the power of killing bacteria: a real antibactericidal power. Second, as a solvent for albumin. Thus, it is apparent that pathogenic micro-organisms that might have entered the stomach can be destroyed, although we know the small quantity of acid is hardly able to cope with large quantities of food contaminated with bacteria.

CHAPTER II.

Action of the Saliva on Various Bacteria.

Triolo[2] describes a series of interesting experiments with saliva. He first irrigated the mouth with bichloride or permanganate-of-potash solution, followed by irrigation with sterilized water until the disinfecting substances were removed, and then inoculated the surface of various culture-media with the sputum. His results proved that saliva possesses a distinct antibactericidal property, for cultures of five-day-old bacteria were destroyed, as well as fresh bacteria eighteen hours old.

This property, however, was lost when saliva was filtered. The saliva of the parotid and submaxillary glands, taken singly, were equally efficacious as their combined secretion. He believes that the greatest bactericidal action is due to the secretion of the mucous glands in the mouth.

The Influence of Gastric Juice on Pathogenic Germs.

Gastric juice is, according to the experiments of Drs. Kurlow and Wagner,[3] an exceedingly strong germicidal agent, and when living bacilli get into the intestinal canal it is due to various conditions entirely independent of the gastric juice. When the latter is normal and in full activity, only the most prolific microbes—such as tubercle bacilli, the bacilli of anthrax, and perhaps the staphylo-

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[2] Rivista d'Igiene e di Med. Prat., Neapel.

[3] Vracht; Lancet, March 22, 1890.

cocci—escape its destructive action; all others are destroyed in less than half an hour. Similar influences exist in the intestines, as proved by inoculation with the cholera bacilli.

Judging from the results of experiments made by Zagari, Straus, and Wurtz, who exposed various pathogenic organisms, among others that of tuberculosis, to the action of gastric juice, we must come to the conclusion that, so long as the gastric juice retains a sufficient degree of acidity, tuberculosis of the alimentary canal will be unlikely to occur.[4]

[4] Canadian Practitioner, April 1, 1890.

CHAPTER III.

Stomach-capacity.

At birth the infant's stomach has a capacity of from 9 to 11 drachms, or 35 to 43 cubic centimetres.

At the end of 1 month it is about 2 ounces, or 60 cubic centimetres.

At the end of 3 months the gastric capacity is about 4 times the amount at birth. This very rapid increase from birth to this time soon ceases, and the stomach capacity grows in size, but at a much slower rate of development. (Baginsky.)

The series of experiments at the Children's Hospital at St. Petersburg, made by Ssnitkin, showed that the weight, and not the age, determined the capacity of the stomach, and should be used as a guide for the quantity of infant-food required.

If the normal (initial) weight of an infant is 3000 to 4000 grammes, or about 6.6 to 8.8 pounds, then $^1/_{100}$ part, plus the daily increase in weight added, which normally amounts to $^2/_3$-1 ounce, would give the amount of food required.

Biedert also regards the body-weight as an important factor in determining the amount of milk to be given, but Baginsky argues that, while this rule will hold good for a great many infants, he must insist on relying upon the *scales* to show just how much nutriment has been digested, and thus a regular system of weighing plus the inspection of the stools will aid in establishing the quantity of food necessary. "There is no unanimity among experi-

enced clinical observers upon the subject of infant-feeding." Thus, for example, while the great majority of clinicians the world over order milk (cows') in varying dilutions, some using the cereals—like wheat, barley, rice, and farina—to dilute and subdivide the curd, other clinical observers—Budin and Variot, French observers—*advise giving infants at birth whole milk*; *that is, pure, undiluted cows' milk.*

The following illustrations will serve to show *the difference in the capacity of infants' stomachs at various ages, taken by the author at the morgue of Bellevue Hospital*:—

Fig. 1.—Infant's Stomach, 1 Month Old. Actual Size. From a Case of Malnutrition. Capacity, about 2 Ounces. When Stomach was Filled it Held 4 Ounces Easily. (Author's Collection.)

Fig. 2.—Infant's Stomach. Actual Size. Died Suddenly from Convulsions. Age, 7 Months. Cause of Death, Eclampsia. Capacity when Filled with Water, 8 3/4 Ounces. (Drawn from Specimen in Author's Collection.)

Fig. 3.—Infant's Stomach. Capacity, 10 Ounces. Age of Child, 11 Months. Cause of Death, Enteritis. (Drawn from Specimen in Author's Collection.)

Fig. 4.—Capacity by Measurement, 14 Ounces. Diseased Condition. Normal Capacity, holding about 2 Ounces, or 50 Cubic Centimetres.

Fig. 5.—Infant's Stomach, 1 Month Old. Cause of Death, Malnutrition.

Fig. 6.—Infant's Stomach. Actual Size. Age, 7 Months. Cause of Death, Eclampsia. Convulsions. Capacity, 8 3/4 Ounces.

Fig. 7.—Infant's Stomach. Actual Size. Age, 11 Months. Capacity, 10 Ounces. (With kind Assistance of Dr. J. Henry Wurthman.)

CHAPTER IV.

Ferments and Their Actions.

In newborn children the parotid alone contains ptyalin. The diastasic ferment seems to be developed in the submaxillary gland and pancreas at the earliest after two months. Hence it is not advisable to give starchy foods to infants.

Ptyalin, the diastase of the saliva, a hydrolytic ferment, or enzyme, of the group of unorganized ferments, acts only within a certain range of temperature, being most active about 40° C. It acts best in a slightly-alkaline or neutral medium. Its action is permanently destroyed by boiling.

Amylopsin, the diastasic ferment of the pancreatic juice, seems to be identical with ptyalin, but it acts much more energetically on raw starch, as well as upon boiled starch; at the temperature of the body the change is almost instantaneous. At a low temperature this change takes place slowly.

According to Musculus, O'Sullivan, and von Mering, ptyalin and amylopsin change starch and glycogen (animal starch) into dextrin and maltose.

Erythrodextrin is first formed, then achroödextrin, and, from achroödextrin, maltose. At 40° C. maltose is slowly changed into dextrose. (Landois and Sterling.)

Dextrose and maltose turn the plane of a ray of polarized light to the right. The general term grape-sugar was used formerly to include dextrose (glucose) and maltose.

The existence of maltose (though described by Du-

brunfaut in 1847) was for a long time doubted until O'Sullivan, in 1872, confirmed the previous experiments. (Foster.)

In commerce the term "grape-sugar" is applied to the solid product of the "grape-sugar works," the liquid product being known as "glucose."

Maltose is the end-product of the action of malt-diastase on starch, and can be also formed as an intermediate product in the action of dilute sulphuric acid on the same substance. It also appears to be the chief sugar formed from starch by the diastasic ferments contained in the saliva (ptyalin) and pancreatic juice (amylopsin). (Halliburton.)

The diastasic action of succus entericus, the fluid of the small intestine, is incomparably weaker than ptyalin or amylopsin, and seems only to continue their action. According to Schiff, Busch, Quincke, and Garland, it does not form maltose from starch (Eichhorst states that the juice of the large intestine will do this), but changes maltose, which is usually the ulterior product obtained by the action of ptyalin and amylopsin, into dextrose. The greater part of the maltose is absorbed unchanged. Maltose and dextrose are both crystalline.

Bourquelot thinks that the change from maltose to dextrose is due to the action of the intestinal schizomycetes, and not to the intestinal juice as such, the saliva, gastric juice, or invertin. (Landois and Sterling.)

An important property of dextrose is its power of undergoing fermentations. When an aqueous solution of dextrose is submitted to the influence of yeast, alcoholic fermentation results, yielding alcohol and carbonic anhydride. Lactic fermentation occurs in the presence of decomposing nitrogenous matter, especially of casein, and

is probably the result of the action of a specific ferment. The first stage is the production of lactic acid; in the second, butyric acid is formed, with evolution of hydrogen and carbonic anhydride. (Foster.)

Glucose is easily fermentable. (Landois and Sterling.)

The glucoses are the only sugars capable of direct fermentation; of these, dextrose is more readily decomposed by yeast than is lævulose.

Certain other sugars are capable of indirect fermentation by yeast; among these are cane-sugar and maltose; they are first, however, hydrolyzed to glucose. (Jago.)

Sucrose (cane-sugar) is not readily absorbed by the intestinal mucous membrane until it has been transformed into glucose.

Glucose (like maltose) is taken directly into the circulation. (Flint.)

The gastric juice slowly changes cane-sugar into glucose.

According to Cl. Bernard, invertin in the intestinal juice converts cane-sugar into invert-sugar, which is a mixture of lævulose and dextrose. (Landois and Sterling.)

Dilute acids convert cane-sugar into invert-sugar, which consists of equal parts of dextrose and lævulose.

When subjected to the action of ferments, cane-sugar is first transformed into invert-sugar, then into alcohol and carbonic acid (vinous fermentation). (Battershall.)

Succus entericus has been said to change cane-sugar into grape-sugar and by a fermentative action to convert cane-sugar into lactic acid, and this again into butyric acid, with the evolution of carbonic acid and free hydrogen. (Foster.)

Lævulose is isomeric with dextrose, but it turns the plane of a ray of polarized light to the left; it is non-crystallizable and ferments with difficulty. (Landois and Sterling.)

Lactose, when isolated, is incapable of direct alcoholic fermentation, but milk itself may be fermented. Lactose, however, is directly capable of undergoing lactic and butyric fermentation. (Foster.)

The theory—which a few years ago was accepted—that carbohydrates, to be absorbed, must be in the form of glucose is now known to be wrong.

Lactose and maltose are absorbed without change, and probably some of the dextrins. (Roberts.)

Lactose is a readily-soluble and diffusible body, and, by virtue of these properties, does not require to undergo change within the alimentary canal to be rendered fit for absorption. (Pavy.)

CHAPTER V.

Another Property of Gastric Juice.

Another property of gastric juice in infants is the transformation of albumin in the following manner: (1) albumose; (2) then peptone; (3) and lastly syntonin. It is thus apparent that, although the infantile stomach plays a subordinate rôle as a nourishing organ, it cannot be denied that fluid substances—like water, a solution of salt, and solution of sugar—are absorbed, and in a lesser degree also albumin. The relative size and capacity of the stomach prevent the function from being as thoroughly developed as in the adult.

Length of Intestine.

The relative length of the intestine in nurslings is larger than in adults; so that the length is six times as great as the length of its body. Forster believes that is one reason why nurslings receive more nourishment from milk than adults. The small intestine develops during the first two months of life more than the large intestine, and after the second month the reverse is true. The duodenum remains relatively the longest until the end of the fourth month. The transverse colon is the widest and most elastic portion of the large intestine. The continuation of the large intestine in infants into the rectum is indicated by a narrowing at this point.

The relative length of the large to the small intestine is stated by Frolowsky to be in the newborn, 1 to 6; in nurslings, 1 to 5; in adults, 1 to 4.

Formation of Gas in the Intestine.

When we consider the lesser development of the muscles of the intestine, we can readily understand that peristaltic movements are more irregular and less forcible, and the muscles possess less tone; for this reason *there is a larger amount of gas contained in the intestine, which constantly distends it.* Thus it is apparent why the abdomen always appears larger in the infant in proportion to the other parts of the body.

Action of Intestinal Muscles.

The action of the intestinal muscles is chiefly to transport the food by a series of peristaltic movements. Parts of the intestine are active, while others remain passive. Heubner maintains that post-mortem examinations never show all parts of the intestine in the same condition, owing to the irregularity of the muscular movement.

Development of Glandular System.

The development of the glandular system in infants is very poor, whereas the *lymphoid tissues, follicles, are comparatively well developed.*

Lieberkühn's glands are fewer in number than in adults, whereas the Brunner glands in the duodenum are numerous and well developed.

The Secretory and Absorbing Power of the Epithelium and the Glands.

Heubner maintains that the secretion takes place from cells, located in the small intestine, which are scattered about and few in number, whereas in the large intestine they are far more numerous.

Absorption of Fat.

The absorption of fat takes place through the intestinal epithelium in the duodenum and jejunum. This absorption of fat takes place from the epithelium lying on the superficial surface, whereby, also, the glands participate. This absorption of fat, according to the histological investigations of Baginsky, takes place in the connective-tissue bodies of the mucous membrane of the infantile intestine, in which are located lymphatic vessels connected with the larger lymph-channels of the intestine, which is the real absorbing system of the intestinal wall. Thus it is apparent that the power of absorption in nurslings is better developed and functionates better than in adults. The physiological and chemical functions are far less developed in infants than in adults because the intestinal glands are relatively less developed.

CHAPTER VI.

Liver in Nurslings.

The liver in nurslings is relatively larger than in adults.

Bile.

The quantity of bile in the gall-bladder is very small. It is of a golden-yellow color, and has a neutral reaction. Its specific gravity varies from 1.014 to 1.053. According to Baginsky, the bile in nurslings contains organic salts,—cholesterin and lecithin,—fat, and various acids in lesser proportion than in adults. Baginsky was able to demonstrate the presence of glycocolic acid. Thus it is apparent that the presence of a much lesser quantity of the bile-acids in the infant is a beneficial physiological condition. It is a well-known fact that these acids inhibit the digestive action of the pepsin, as well as the pancreatic juice. Another point is that the absence of a bile-acid prevents the assimilation of large quantities of fat, as it is impossible to split up the fat into fatty acid and glycerin. Thus, fermentative processes are much more frequent in nurslings and appear with greater intensity than in the adult, because of the absence of the biliary acids. The amylacea and all substances containing flour are—owing to the above-described condition of the pancreatic juice and the bile—not fit substances to give the infant, especially during its first three months of life, although very small quantities can be digested, and after the fourth month are not only digested, but absorbed. Baginsky and Sommerfeld found large quantities of mucin in the bile.

Unorganized Ferments.

Table Showing the Unorganized Ferments Present in the Body and Their Actions.

Fluid or Tissues.	Ferment.	Actions.
Saliva.	1. Ptyalin.	Converts starch chiefly into maltose.
Gastric juice.	1. Pepsin.	Converts proteids into peptones in an acid medium, certain by-products being formed.
	2. Milk-curdling.	Curdles casein of milk.
	3. Lactic-acid ferment.	Splits up milk-sugar into lactic acid.
	4. Fat-splitting.	Splits up fats into glycerin and fatty acids.
Pancreatic juice.	1. Diastasic, or amylopsin.	Converts starch chiefly into maltose.
	2. Trypsin.	Changes proteids into peptones in an alkaline medium, certain by-products being formed.
	3. Emulsive (?).	Emulsifies fats.
	4. Fat-splitting, or steapsin.	Splits fats into glycerin and fatty acids.
	5. Milk-curdling.	Curdles casein of milk.
Intestinal juice.	1. Diastasic.	Does not form maltose, but maltose is changed into glucose.
	2. Proteolytic.	Fibrin into peptone (?).
	3. Invertin.	Changes cane-sugar into grape-sugar.
	4. Milk-curdling.	In small intestine (?).
Blood. Chyle. Liver (?). Milk. Most tissues.	Diastasic ferments.	
Muscle. Urine.	Pepsin and other ferments.	
Blood.	Fibrin-forming ferment.	

The unorganized ferments seem to be nitrogenous bodies; their exact composition is unknown, and it is doubtful if they have ever been obtained perfectly pure. (Landois and Sterling.)

Organized Ferments.

Yeast is the type of the living, or organized, ferments.

Other living ferments, schizomycetes, seem to be produced from the numerous fungi introduced into the intestinal canal with the food and drink. (Landois and Sterling.)

The action of these organized ferments is now ascribed to certain minute microscopic organisms; when the result is the production of some useful body the change is termed "fermentation," and "putrefaction" when the products are useless and offensive.

Briefly stated, a liquid free from ferment-organisms or their germs does not undergo fermentation. (Jago.)

The lactic fermentation and putrid or butyric fermentation of milk are both due to mysteriously-minute bacteroid bodies. (Blyth.)

The fungi which occur everywhere in the atmosphere are the cause of the spontaneous acidification and subsequent coagulation of milk. (Landois and Sterling.)

The fermentation of carbohydrates, fats, and proteids is believed to be caused by these micro-organisms.

Each particular organism has its special product of fermentation. (Jago.)

Hydrolytic Agents.

These bodies include oxalic and dilute hydrochloric and sulphuric acids.

Commencing with soluble starch, these acids possess the power of converting the body first into dextrin and maltose, and then into glucose.

The acid hydrolytics also transform cane-sugar into glucose.

There is another most important group of hydrolyzing agents; these consist of certain soluble bodies of organic origin, and among them may be mentioned human saliva, filtered aqueous infusion of yeast, flour, bran, and malt.

The following names have been given to active principles of these hydrolytics:—

Substance.	*Name of Hydrolyzing Constituent.*
Human saliva.	Ptyalin.
Yeast.	Zymase, or invertin.
Flour and bran, especially the latter.	Cerealin.
Malt.	Diastase. (Jago.)

Absorption.

As most substances in the state in which they are used for food are either insoluble or diffuse but imperfectly through membranes, the complicated digestive processes render these substances soluble and diffusible, and thus fit them for absorption; most of the fats are emulsionized. The mucous membrane of the intestinal tract from the cardiac orifice of the stomach to the anus is adapted for absorption. In the stomach, watery solutions of salts, grape-sugar, maltose, peptone, and poisons, especially alcoholic solutions of poisons, are absorbed. The empty stomach absorbs more rapidly than one filled with food. Gastric catarrh delays absorption. The greatest area of absorption is undoubtedly the small intestine. (Landois and Sterling.)

Table of the More Important Carbohydrates and Their Formulæ.

Cellulose	$C_6H_{10}O_5$.
Starch	$C_6H_{10}O_5$ or $n(C_6H_{10}O_5)$.
Dextrin	$C_6H_{10}O_5$.
Maltose	$C_{12}H_{22}O_{11}$ or $C_{12}H_{22}O_{11} + H_2O$.
Dextrose (glucose, grape-sugar)	$C_6H_{12}O_6$ or $C_6 + H_{12}H_2O$.
Sucrose (saccharose, cane-sugar)	$C_{12}H_{22}O_{11}$.
Lævulose	$C_6H_{12}O_6$.
Invert-sugar	$C_6H_{12}O_6$.
Lactose (milk-sugar)	$C_{12}H_{22}O_{11}$ or $C_{12}H_{22}O_{11} + H_2O$.

The sugars are classified into three groups, as given below, with their important members:—

(*A*) Saccharoids (non-fermentable sugars):—

Mannite (from manna)	$C_6H_{14}O_6$.
Dulcite	$C_6H_{14}O_6$.

(*B*) Glucoses:—

Dextrose (grape-sugar, starch-sugar)	$C_6H_{12}O_6 + Aq$.
Lævulose (honey)	$C_6H_{12}O_6$.

(*C*) Saccharoses:—

Sucrose (cane-sugar)	$C_{12}H_{22}O_{11} + Aq$.
Maltose (malt-sugar)	$C_{12}H_{22}O_{11} + Aq$.
Lactose (milk-sugar)	$C_{12}H_{22}O_{11} + Aq$.

Cellulose.

Cellulose acts mainly as a sort of connective tissue constituting the frame-work of vegetable organisms.

Enzymes.

The enzymes, hydrolytic or organic ferments, act only in the presence of water; they are most active between 30° and 35° C., and are destroyed by boiling. (Landois and Sterling.)

Hydrolysis.

The changes which carbohydrates undergo have been called by the general name of hydrolysis. (Jago.)

Hydrolysis, when affected by diastase or its congeners, is termed diastasic action, or diastasis.

The ultimate products of diastasis of starch are sugars of various kinds; the process of conversion is frequently termed the saccharification of starch.

Soluble Starch.

Researches of Brown, Heron, and others make it probable that the formula of starch is more complex than usually expressed by $C_6H_{10}O_5$, and the formula $n(C_6H_{10}O_5)$ is now used, n expressing the unknown.

Soluble starch is expressed by the formula, $n(C_{12}H_{20}O_{10})$.

Starch is soluble in cold water, and cannot be dissolved by any known liquid without change, it having a definite organic structure, an outer envelope of cellulose inclosing the starch proper (amylose, or granulose).

The cellulose envelopes may be ruptured by mechanical means or by boiling in water; in the latter case the containing cellulose bursts, from the interior particles swelling, and the amylose dissolves in the water, forming a viscous liquid (gelatinization).

A solution of starch (soluble starch) is colorless, odorless, and tasteless, but is colored an intense blue by the addition of iodine in extremely small quantities. (Jago.)

Dextrin is very soluble in water; it can be prepared from starch by action of heat maintained at a temperature of about 150° C.

Starch, boiled with dilute sulphuric acid, will be con-

verted into dextrin and maltose, and by continued boiling most of the dextrin and maltose is transformed into glucose (dextrose).

Action of Malt-diastase.

The action of malt-diastase on a solution of starch in water at temperatures from 15° C. to about 70° C. more or less rapidly hydrolyzes the starch into a mixture of dextrin and maltose. The longer the operation is continued, the higher is the proportion of maltose produced; but even prolonged boiling does not result in any further hydrolysis of the maltose into glucose.

Unlike the acids, malt-diastase is incapable of converting starch further than into dextrin and maltose. (Jago.)

Brown and Heron's results lead to the opinion that there are several dextrins. And these dextrins are divided into two groups: erythrodextrins, those first forms; and achroödextrins (reducing dextrins). They also think that there is an intermediate body between dextrin and maltose which they call maltodextrin.

According to Musculus and Gruber, erythrodextrin is a mixture of dextrin and soluble starch.

Dextrin does not undergo alcoholic fermentation; but, after dextrose is formed from it, the dextrose is capable of directly undergoing vinous fermentation. (Foster, Battershall.)

CHAPTER VII.

Fat.

Fat contained in milk is no simple compound. It consists of at least nine compounds. More fat is found in colostrum, in evening milk, and in upper layers of pail or bowl of milk. Its average percentage is 4.3 per cent.: a great deal more than in human milk. For this reason Jacobi[5] has always taught that "it is better to reduce the fat to be given to infants than to increase it."

The deficiency of butter does, however, seriously impair the nutritive value of the milk.

When there is not enough butter in the milk the casein present is digested with more difficulty, and the result is the same as if the casein were in excess.

The plastic (building) materials of food cannot be converted into the tissues of the body without the presence of fat. Fat seems to be essential to the formation of new cells, whose nucleoli always contain fat, and there is more in young and rapidly-growing tissues than in those whose growth has been slackened by maturity. From this is evident the immense importance of fat in the nutrition of the rapidly-growing infant-body.

Sugar.

The effects of the deficiency of sugar will be partly the same as when butter is deficient, for the reason that

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[5] A. Jacobi, "Intestinal Diseases of Infancy and Childhood," page 87.

sugar partly supplies the place of butter and partly is converted into fat.

Other substances that result from the decomposition of sugar are of importance in many ways. Lactic acid is formed in the stomach, helps to give acidity to the gastric juice, and thus assists in the digestion of casein.

Milk in which sugar is deficient frequently becomes a source of constipation in the child. (Jacobi.)

Carbohydrates.

This name is given to a class of compounds containing six, or some multiple of six, atoms of carbon united with hydrogen and oxygen, the latter two in the same proportion as in water, H_2O; for illustration, the carbohydrate, starch, is expressed by $(C_6H_{10}O_5)n$ (simplest formula).

Hydrocarbons.

Numerous compounds of carbon with hydrogen are classed under the general name of hydrocarbons; the generic formula $CnH_2n + 2$ is applied to such hydrocarbons as petroleum, marsh-gas, and oils formed by the dry distillation of coal, wood, etc. (turpentine, etc.).

Fats.

In chemical constitution fats consist of the ethers of the higher fatty acids.

Butyrin, or butter-fat, has the formula $C_2H_5(C_4H_7O_2)_3$.

Lard contains palmitin $[C_3H_5(C_{16}H_{31}O_2)_3]$ and stearin $[C_3H_5(C_{18}H_{35}C_2)_3]$.

Castor-oil contains ricinolein [$C_3H_5(C_{18}H_{33}O_3)_3$] and palmitin (as above).

The constitution of many fats and fixed oils is undetermined.

Another source of fat is its formation from albuminous bodies. (Landois and Sterling.)

While nitrogenous matter is mainly devoted to tissue-formation, the non-nitrogenous alimentary principles —the fats and the carbohydrates—supply the source of power,—are appropriated to force-productions.

The term "hydrocarbons" has been applied by many writers to fats.

The fats are a class by themselves. The hydrocarbons are marsh-gas, benzin and its homologues, and resemble the fats in many ways, but exhibit decided peculiarities, which mark them as a distinct group.

The fats have the general formula of $C_{10}H_{18}O$.

Fats are easily oxidized, yielding heat chiefly, and belong, therefore, to the calorifacient group.

There is every reason to believe, however, that fat is essential to tissue-development, as it seems to be intrinsically mixed up with nitrogenized matter in the animal tissues.

Though fats cannot, *per se,* supply what is required for tissue-development, they, nevertheless, take part in the process. (Pavy.)

Fat is absorbed in the form of an emulsion produced by the action of the bile and pancreatic juice; the villi of the small intestine are the chief absorbents, but the epithelium of the stomach and that of the large intestine also take a part. (Landois and Sterling.)

The fats and the carbohydrates seem to be quite closely allied.

Part of the fat of the body is derived directly from the fat of the food, and it is absorbed and deposited in the tissues.

According to V. Voit, no fat is formed in the body directly from carbohydrates.

Lawes and Gilbert, Heiden and V. Wolff arrived at the conclusion that the carbohydrates absorbed are directly concerned in the formation of fats. We must assume that the carbohydrates are consumed or oxidized in the body and that thereby a non-nitrogenous body derived from the proteids is prevented from being burned up, and that it is changed into fat and stored up as such. No doubt, fat is formed indirectly in the blood in this way. (Landois and Sterling.)

The balance of evidence seems to be in favor of the view that carbohydrates may be in some way directly converted into fat.

The characteristic feature of proteid food is that it increases to oxidative, metabolic activity of the tissues, leading to a rapid consumption, not only of itself, but of non-nitrogenous food as well.

One value of fats and carbohydrates lies in their being sources of energy, more than three-quarters of the normal income of potential energy coming from them, and they are ultimate sources of muscular energy as well as of heat; but their great characteristic is that they do not, like proteid food, excite the metabolic activity of the body, and therefore, instead of giving rise to bodies demanding immediate excretion from the system, can deposit their metabolic products as apparently little-altered, but in reality greatly-changed, fat. (Foster.)

Salts.

The several saline matters, including the extractives of animal and vegetable food, are no less essential elements of a diet than proteids, fats, or carbohydrates; by reason of their regulating the energy of foodstuffs, more strictly called, they are necessary to life; the body in their absence fails to carry out its usual metabolism, and disease, if not death, follows.

The salts must have important functions in directing the metabolism of the body. The striking distribution of them in the tissues, the preponderance of sodium and chlorides in blood-serum and of potassium and phosphates in the red corpuscles, must have some meaning, though we are in the dark concerning it.

Salts and Water.

The element phosphorus seems no less important than carbon or nitrogen; the element sulphur, again, is only second to phosphorus, and is a constituent of nearly all proteids.

We know that the various saline matters are essential to health; that when they are not present in proper proportions nutrition is affected; that the properties and reaction of various proteid substances are closely dependent on the presence of certain salts; but beyond this we know very little.

Lastly, water has an effect on metabolism, as shown by the fact that, when the water of a diet is increased, the urea is augmented to an extent beyond that which can be explained by the increase of fluid augmenting the facilities of mere excretion. (Foster.)

Albuminous, or Proteid, Substances.

The proteids form a large group of closely-related substances, all of which are, perhaps, modifications of the same body. The infant manufactures most of the proteids of its ever-growing body from the casein of milk. Their chemical constitution is quite unknown. Some are soluble, others insoluble in water. The most important nitrogenized principles used as food are musculin, albumin, casein, fibrin, gelatin, and gluten. The product of the digestion of such principles in the stomach was called, by Mialhe, albuminose; afterward, by Lehmann, peptones. This change renders them not easily coagulable and endosmotic, so that they pass through membranes with facility and are readily assimilated after their absorption. (Flint.)

Nitrogenous alimentary matter may be said to serve principally for the development and renovation of the living tissues.

As to the production of a fat as a result of the splitting up of nitrogenous matter, it is highly probable that such production takes place, but anything in the nature of proof of this is wanting.

The nitrogenous compounds are mainly "histogenetic," or tissue-forming, materials, but, by the separation of urea which occurs in their metamorphosis in the animal system, an hydrocarbonaceous compound is left, which may be appropriated to heat-production. (Pavy.)

The nitrogenous bodies of milk are not thoroughly understood, and are too frequently classed under one head: proteids.

For about five days after calving colostrum is secreted by the mammary glands. This colostrum is poor

in fat and sugar, but rich in proteids, which vary between 15 and 20 per cent. These proteid bodies are not well understood, but albumin is about two-thirds of the total quantity. Casein is also present. Colostrum is curdled by rennet, but not as easily as milk, and it is interesting to note here that, for commercial purposes, the stomach of a calf under four days old is practically worthless for furnishing rennet. It is well known that large quantities of albumin are absorbed without peptonization; so it would be seen that Nature intended to furnish a very digestible food for the first few days of life. By the fifth or sixth day normal milk is secreted, the change from colostrum to milk being gradual, the quantity of albumin decreasing until in the normal milk it runs about 0.4 per cent. When the secretion ceases to coagulate on boiling, it is considered milk.

Proteids.

The division of the various component parts of milk by Baginsky into fat, carbohydrate, albumin, casein, salts, and water gives a clearer insight into the vital necessities of a growing infant. We have adopted this division from a clinical stand-point, because frequently a chemical report of an examination of breast-milk will show "deficient proteids," and hardly convey to the unskilled which vital element is lacking. If, however, deficient albumin and casein were noted, instead of combining the two as one element and calling them proteids, then raw albumin, as the white of egg or yolk of egg, would suggest themselves to remedy the element found wanting. I shall, therefore, speak of "deficient albuminoids" and "deficiency in casein" rather than combine these elements

under the one heading of proteids, which is now being used by so many text-books.

A Clinical Method for the Estimation of Breast-milk Proteids.[6]

"Two 'milk-burettes,' each containing 5 cubic centimetres of milk, are subjected to a temperature warm enough rapidly to sour the milk, and are allowed to remain in this warmth until a distinct precipitation can be seen. The burettes are then cooled in water, the milk-serum is withdrawn into the graduated tubes, 10 cubic centimetres of Esbach's solution (picric acid, 5 grammes;

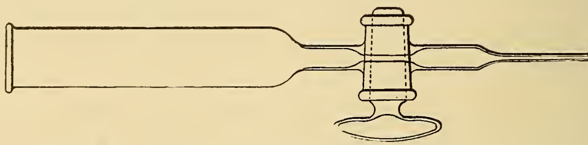

Fig. 8.—Woodward's Burette for Estimating Proteids.

citric acid, 10 grammes; water, 500 cubic centimetres) are added, the tubes are shaken, and centrifugated until constant reading, and the resulting precipitate is read. This reading expresses in percentage the amount of total proteids in the milk.

"Such is a bare statement of the method. I will briefly take up the various steps in detail. The 'milk-burettes' are made of about 10 cubic centimetres' capacity, and have a glass pinch-cock or valve and a narrow exit-tube about one inch long (Fig. 8). I have tried various forms of burettes and separating funnels, and find this

[6] Reprinted in large part from George Woodward's article in the Philadelphia Medical Journal, May 21, 1898.

the most satisfactory. A temperature of from 95° F. to 100° F. is the most rapidly effective to produce fermentation. This I have conveniently obtained by placing the tubes in a burette-stand and the stand in contact with a radiator. The time required to obtain a distinct precipitation of casein is from eighteen to twenty-four hours. At the end of this time the milk has distinctly separated into an upper layer of viscid yellow fat; a lower layer of fluid milk, quite opaque above, almost translucent below; and, clinging to the sides of the tube, and especially at the bottom, a granular precipitate. The cooling of the milk increases the viscidity of the fat and facilitates its separation from the milk-serum. The milk-serum is received into 15-cubic-centimetre graduated tubes, the solution of picric and citric acids added up to the 15-cubic-centimetre mark, the mixture stirred with a glass rod and placed in the hand-centrifuge. The amount of centrifugation required is in direct proportion to the care used in separating the fat. If fermentation be watched and the separation be made as soon as the casein-precipitate is distinctly present, the centrifugation to a constant reading may be quickly accomplished."

Lime-salts in Cows' Milk.

Milk curdles under two entirely-distinct sets of conditions: (1) it curdles on addition of an acid and (2) it curdles under the influence of rennet (when the reaction of the milk is either neutral or slightly acid). The two varieties of curd which are obtained under these circumstances may be denominated "acid curds" and "rennet curds," respectively. Acid curds must inevitably be formed in the stomach after milk has been drunk, if the

gastric contents are allowed to become acid. Such curds (we are familiar with them in ordinary life in the form, for instance, of cream-cheese or sour milk) are probably not sufficiently firm to set up digestive disturbances. On the other hand, rennet curds (such as we are familiar with in the form of renneted milk and of ordinary cheese) may be extremely firm. It is, therefore, in all probability these rennet curds which set up the familiar infantile dyspepsia of bottle-fed children. If this is so, the facts elicited by Arthus and Pages would appear to be of dominating importance in the treatment of these dyspeptic conditions. In order to appreciate this correctly the following facts must be attended to: (1) rennet-coagulation is delayed and curdling becomes less and less firm as an increasing proportion of the lime-salts of the milk becomes precipitated as insoluble salts (Arthus and Pages); (2) addition of soluble lime-salts (up to a certain maximum) causes increased rapidity of rennet-coagulation, accompanied by increased firmness of clot (Arthus and Pages); (3) human milk contains 0.03 per cent. of lime (Bunge); (4) cows' milk contains 0.17 per cent. of lime (Bunge). (*Lancet.*)

Lime-water and Milk.

Dr. Brunn[7] finds the use of lime-water as an addition to milk a frequent cause of constipation and consequent fissures of the anus in children. Any cause which produces diarrhœa, with following constipation, will cause it. Constipation, proctitis, and severe pains on defecation are the results of a fissure. Hernia and mas-

[7] Hospitals-tidende, R. 3, B. 8, S. 1089; Medical and Surgical Reporter, February 13, 1892, page 277.

turbation are possible consequences. The condition may be long-lasting, although it is easily discovered when attention is called to it. He treats it by regulating the diet, cleanliness, irrigation of the rectum, and dilation of the sphincter ani, which is easily done.

Bicarbonate of Soda in Milk.

The addition of the bicarbonate of soda to milk for its preservation has hitherto been tolerated by the police, but the Council of Hygiene of the Seine has condemned the practice, as it is not free from danger. The transformation of the sugar of milk into lactic acid gives rise, in milk so adulterated, to a lactate of soda, which is purgative, and is thus a cause of diarrhœa in young children. Under these conditions the Council considers that the addition of the bicarbonate of soda to milk, which is an aliment of the first order and very often prescribed for invalids and children, should neither be authorized nor tolerated.[8]

Soda is also added to milk sometimes to delay the souring process. The prohibition of this chemical may be viewed in the light of a stultification when we consider the large amount of bicarbonate of soda that is used at the present day in one of the popular methods of feeding infants. I think it is no less reprehensible on the part of the physician than it is on the part of the dairyman.[9]

Milk-sugar.

Process of Making.—The milk is collected and allowed to stand for several hours in cooling vats; then it

[8] Lancet (London), February 11, 1888.

[9] E. E. Brush, M.D., in the Journal of the American Medical Association, November 23, 1889.

is conveyed to a large tank, to be coagulated. Various substances are used to hasten the coagulation. According to Flint,[10] vinegar, cream of tartar, muriatic acid, and sour milk can be used to produce coagulation, but, of course, rennet is the most popular and most commonly used agent. This, as we all know, is the fourth stomach of the calf. The directions given for preparing rennet are as follow: "Care must be taken not to use too much water in cleaning; wiping lightly with a moistened cloth until it is clean is the better way. If then blown up like a bladder and hung up and dried, it will retain its power for coagulating milk for years." Pieces of this rennet are steeped in warm water, and the solution from it is added to the milk and then the milk is raised to a temperature above 100° and kept at that until coagulation takes place. Then the whey is drawn off, and this whey is evaporated by boiling to one-fifteenth of its original mass. This is dipped out into a tub, where the sugar will crystallize in twenty-four to forty-eight hours. These crystals are known as "sand"; this sand is put into sacks, from which the water drains off. The sand is again boiled in water to a sufficient concentration, and the sugar is allowed to crystallize in sticks. It will thus be seen that many of the other crystallizable bodies contained in milk would be included in this crystallization, as well as the alkaloids or ptomaines.

The use of milk-sugar has increased notably during the last few years, in the feeding of children, through the recommendations of Soxhlet and Reubner. It is not generally known, however, that under some circumstances the

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[10] "Milk-cows and Dairy-farming."

milk-sugar of cheaper sorts may be contaminated by the presence of bacteria, derived from the milk from which it is made. In repeated examinations the author has found a large number of bacteria, and among them those which lead to the formation of gas: a form particularly feared because of its power to decompose milk. If such milk-sugar be added to sterilized milk it quickly curdles it; if, also, a small quantity of such sugar be added to a sterile milk, and subjected to the usual sterilizing methods for twenty or even forty minutes it is not as certainly rendered free from germs as is the case with ordinary milk. Enough germs, however, are destroyed so that the milk will not spoil until the second or third day. With the Soxhlet method of preparing the milk it was found that a very impure milk-sugar could be used without harm, provided it was used up within twenty-four hours. It was quite another matter when, as the author found, certain vendors of sterilized milk added the powdered sugar after the sterilization process. Through the addition of the impure milk-sugar, countless germs were introduced into the sterile milk, and, since the milk is only slightly warmed before feeding, they enter the alimentary canal of the child, where they may produce the very evils one has sought to avoid. Under such circumstances the use of the relatively-sterile beet- or cane- sugar is preferable. From this is derived the practical rule that cheap grades of milk-sugar should be avoided in the preparation of the food of infants, or at least that they should be used only before a careful sterilization of the milk. (H. Neumann.[11])

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[11] Berliner klinische Wochenschrift; American Medico-Surgical Bulletin.

Dr. E. E. Brush,[12] of Mount Vernon, N. Y., says that one of the faults of physiological chemists is that they make no distinction between a substance existing in a natural condition and that substance eliminated and isolated by chemical means. Thus, the sugar of milk of commerce and the sugar of milk as it exists in that fluid are regarded by the chemists as one and the same thing. Hence, the physician has been led into the error of thinking that as the sugar in milk is that designed by nature as the best saccharine nutrient, therefore the isolated sugar must fulfill the same function. This is not the truth. Sugar of milk in that fluid is all assimilated, and the milk-sugar of commerce, when added to baby food, is eliminated both by the kidneys and bowels. This I have demonstrated by numerous experiments. I have never found sugar present in the urine or fæces of babies fed at the breast, but in three cases of infants fed with mixtures containing commercial milk-sugar to the amount of 3 ounces or more in twenty-four hours (as in Meig's mixture) I have always found sugar in the urine and fæces demonstrated by Fehling's test.

Impurities in Milk-sugar.—J. O. Braithwaite[13] states that the new United States Pharmacopœia methods of testing milk-sugar do not suffice, because they consider only the contents in grape-sugar and cane-sugar. He found in a great number of samples a disproportionately high residue of ash, which coagulates milk when the latter is heated to nearly the boiling-point. This is a serious defect, since milk-sugar serves now mainly as a material for preparing artificial food for infants. The author

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[12] Journal of the American Medical Association, July 5, 1890.
[13] London Pharm. Journal, April 14, 1894.

found the ashes, in several samples, to consist chiefly of magnesium; he found lime in one sample; and concludes that, during the preparation of the sugar, magnesium carbonate and lime had been used for neutralizing the acid solution, and that, during crystallization, magnesium lactate had crystallized out with the milk-sugar. The author confirmed, by way of experiments, the well-known fact that many metallic and earthy salts coagulate milk, and that magnesium lactate does so also, even in milk-sugar to which 0.5 per cent. of the salt had been admixed. He proposes that the pharmacopœias restrict the amount of ash from milk-sugar to 0.25 per cent. as a maximum.

Bacteria in Milk-sugar. — Prof. Albert R. Leeds[14] states that all the samples of pulverized milk-sugar coming from drug-stores which he had examined gave an abundant crop of bacteria when definite weights dissolved in sterilized water were submitted to ordinary gelatin-peptone culture; and the presence of bacteria as a common impurity in lactose, to be looked for and avoided by the chemist and the druggist, was sufficiently demonstrated.[14]

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[14] Journal of the American Chemical Society; Oil, Paint, and Drug Reporter, August 31, 1896.

CHAPTER VIII.

Bacterium Coli Commune (Escherich).

Obtained by Emmerich (1885) from the blood, various organs, and the alvine discharges of cholera patients at Naples; by Weisser (1886) from normal and abnormal human fæces, from the air, and from putrefying infusions;

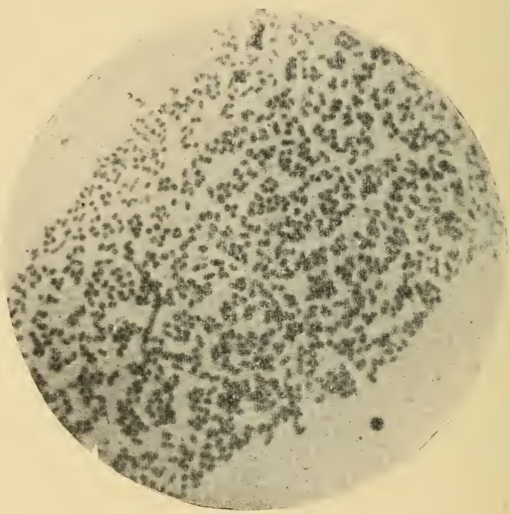

Fig. 9.—Bacterium Coli Commune.

by Escherich (1886) from the fæces of healthy children; since shown to be constantly present in the alvine discharges of healthy men, and probably of many of the lower animals. Found by the writer in the blood and various organs of yellow-fever cadavers in Havana (1888 and 1889).

Numerous varieties have been cultivated by different bacteriologists, which vary in pathogenic power and to some extent in their growth in various culture-media; but the differences described are not sufficiently characteristic or constant to justify us in considering them as distinct species.

Morphology.—Differs considerably in its morphology as obtained from different sources and in various culture-media. The typical form is that of short rods with rounded ends, from two to three microns in length and 0.4 to 0.6 micron broad; but under certain circumstances the length does not exceed the breadth—about 0.5 micron—and it might be mistaken for a micrococcus; again the prevailing form in a culture is a short oval; filaments of five microns or more in length are often observed in cultures, associated with short rods or oval cells. The bacilli are frequently united in pairs. The presence of spores has not been demonstrated. In unfavorable culture-media the bacilli, in stained preparations, may present unstained places, which are supposed by Escherich to be due to degenerative changes in the protoplasm. Under certain circumstances some of the rods in a pure culture have been observed by Escherich to present spherical, unstained portions at one or both extremities, which closely resemble spores, but which he was not able to stain by the methods usually employed for staining spores, and which he is inclined to regard as "involution forms."

The bacillus stains readily with the aniline colors usually employed by bacteriologists, but quickly parts with its color when treated with iodine solution—Gram's method—or with diluted alcohol.

Biological Characters. — An aërobic and facultative anaërobic, non-liquefying bacillus. Sometimes exhibits

independent movements, which are not very active. One rod of a pair, in a hanging-drop culture, may advance slowly with a to-and-fro movement, while the other follows as if attached to it by an invisible band (Escherich). The writer's personal observations lead him to believe that, as a rule, this bacillus does not exhibit independent movements. Does not form spores. Grows in various culture-media at the room-temperature—more rapidly in the incubating oven. Grows in a decidedly-acid medium.

In gelatin plates colonies are developed in from twenty-four to forty-eight hours, which vary considerably in their appearance according to their age, and in different cultures in the same medium. The deep colonies are usually spherical and at first are transparent, homogeneous, and of a pale-straw or amber color by transmitted light; later they frequently have a dark-brown, opaque central portion surrounded by a more transparent peripheral zone; or they may be coarsely granular and opaque; sometimes they have a long-oval or "whetstone" form. The superficial colonies differ still more in appearance; very young colonies by transmitted light often resemble little drops of water or fragments of broken glass; when they have sufficient space for their development they quickly increase in size, and may attain a diameter of three to four centimetres; the central portion is thickest, and is often marked by a spherical nucleus of a dark-brown color when the colony has started below the surface of the gelatin; the margins are thin and transparent, the thickness gradually increasing toward the centre, as does also the color, which by transmitted light varies from light-straw color or amber to a dark brown. The outlines of superficial colonies are more or less irregular, and the surface may be marked by ridges, fissures, or concentric

rings, or may be granular. The writer has observed colonies resembling a rosette, or a daisy with expanded petals. Escherich speaks of colonies which present star-shaped figures surrounded by concentric rings.

In gelatin stick cultures the growth upon the surface is rather dry, and may be quite thin, extending over the entire surface of the gelatin, or it may be thicker, with irregular, leaf-like outlines and with superficial incrustations or concentric annular markings. An abundant development occurs all along the line of puncture, which, in the deeper portion of the gelatin, is made up of more or less closely-crowded colonies; these are white by reflected light, and of an amber or light-brown color by transmitted light; later they may become granular and opaque. Frequently a diffused cloudy appearance is observed near the surface of the gelatin, and under certain circumstances branching, moss-like tufts develop at intervals along the line of growth. One or more gas-bubbles may often be seen in recent stick cultures in gelatin.

Upon nutrient agar and blood-serum, in the incubating oven, an abundant, soft, shining layer of a brownish-yellow color is developed. The growth upon potato differs considerably, according to the age of the potato. According to Escherich, upon old potatoes there may be no growth, or it may be scanty and of a white color. In milk at 37° C., an acid reaction and coagulation of the casein are produced at the end of eight or ten days. In the absence of oxygen this bacillus is able to grow in solutions containing grape-sugar (Escherich). In bouillon it grows rapidly, producing a milky opacity of the culture-liquid. The thermal death-point of Emmerich's bacillus, and of the colon bacillus from fæces, was found by Weisser to be 60° C., the time of exposure being ten minutes.

The writer has obtained corresponding results. Weisser found that when the bacilli from a bouillon culture were dried upon thin glass covers they failed to grow after twenty-four hours. These results give confirmation to the view that the bacillus under consideration does not form spores.

Pathogenesis. — Comparatively small amounts of a pure culture of the colon bacillus injected into the circulation of a guinea-pig usually cause the death of the animal in from one to three days, and the bacillus is found in considerable numbers in its blood. But, when injected subcutaneously or into the peritoneal cavity of rabbits or guinea-pigs, a fatal termination depends largely on the quantity injected; and, although the bacillus may be obtained in cultures from the blood and the parenchyma of the various organs, it is not present in large numbers, and death appears to be due to toxæmia rather than to septicæmia. Mice are not susceptible to infection by subcutaneous injections. Small quantities injected underneath the skin of guinea-pigs usually produce a local abscess only; larger amounts—two to five cubic centimetres—frequently produce a fatal result, with symptoms and pathological appearances corresponding with those resulting from intravenous injection. These are fever, developed soon after the injection, diarrhœa, and symptoms of collapse appearing shortly before death. At the autopsy the liver and spleen appear normal, or nearly so; the kidneys are congested and may present scattered punctiform ecchymoses (Weisser). According to Escherich, the spleen is often somewhat enlarged. The small intestine is hyperæmic, especially in its upper portion, and the peritoneal layer presents a rosy color; the mucous membrane gives evidence of more or less intense catarrhal inflammation,

and contains mucus, often slightly mixed with blood. In rabbits death occurs at a somewhat later date, and diarrhœa is a common symptom. In dogs the subcutaneous injection of a considerable quantity of a pure culture may give rise to an extensive local abscess.

Varieties.—Booker, in his extended studies relating to the bacteria present in the fæces of infants suffering from summer diarrhœa, has isolated seven varieties "which closely resemble bacterium coli commune in morphology and growth in agar, neutral gelatin, and potato, but by means of other tests a distinction can be made between them." These are described as follows:—

Bacillus "d" of Booker.

"Found in two cases of cholera infantum and the predominating form in one serious case of catarrhal enteritis.

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: Colonies grow luxuriantly in gelatin, and thrive in acid and sugar gelatin equally as well as in neutral gelatin. In the latter the colonies closely resemble, but are not identical with, the bacterium coli commune. In acid gelatin they differ very much from bacterium coli commune. The colonies spread extensively, and are bluish white, with concentric rings. Slightly magnified, they have a large, uniform, yellow central zone surrounded by a border composed of perpendicular threads placed thickly together. Sometimes a series of these rings appear, with intervening yellow rings.

"Agar: The colonies are round, spread out, and blue or bluish white. Slightly magnified, they have a pale-yellow color.

"*Stab Cultures.*—Gelatin: In sugar gelatin the surface growth has a nearly-colorless centre surrounded by a thick border, with an outer edge of fine, hair-like fringe; the growth along the line of inoculation is fine and delicate. In neutral gelatin the growth is not so luxuriant as on sugar gelatin; on the surface it is thick and white, with a delicate stalk in the depth.

"Agar: Thick white surface growth with a well-developed stalk in the depth.

"Potato: Luxuriant yellow, glistening, moist, and slightly-raised surface, with well-defined borders.

"*Action on Milk.*—Coagulated into a gelatinous coagulum in twenty-four hours at 38° C., and into a solid clot in two days.

"*Milk-Litmus Reaction.*—Milk colored blue with litmus is changed to light pink in twenty-four hours at 38° C. The pink color gradually fades, and by the second or third day is white or cream color, with a thin layer of pink on top. The pink color extends in a few days about one-half down the clot.

"*Temperature.*—Grows best about 38° C.

"Spores have not been observed.

"*Gas-production.*—Gas bubbles are produced in milk; not observed on potato."

Bacillus "e" of Booker.

"Found as the predominating form in two cases of dysentery, one of which was fatal and the other a mild case.

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: The colony growth varies considerably with slight difference in the gelatin.

In 10-per-cent. neutral gelatin the colonies resemble those of bacterium coli commune. On the second or third day, when the colonies have just broken through the surface and are spread out, it is impossible to distinguish one variety from the other, but as the colonies grow older a difference can generally be recognized. In sugar and acid gelatin the colonies have a clear centre with white border. Slightly magnified, a uniform brown centre surrounded by a brown zone composed of fine, needle-like rays perpendicular to the border. After cultivating for a few generations on acid and sugar gelatin the colonies cease to develop, and either grow in very small colonies or do not grow at all. The activity is regained if cultivated on neutral gelatin.

"Agar: Colonies are large, round, and have a mother-of-pearl appearance. Slightly magnified, a uniform yellow color.

"*Stab Cultures.* — Agar: Luxuriant, nearly colorless surface growth, with well-developed stalk along the line of inoculation in the depth.

"Potato: Golden-yellow, glistening, slightly-raised surface, with well-defined borders.

"*Action on Milk.*—Milk becomes gelatinous in twenty-four hours at 38° C., and in a few days a solid coagulum is formed. Milk colored blue with litmus is reduced to white or cream color in twenty-four to forty-eight hours at 38° C., with a thin layer of pink at the top of the culture. The pink color gradually extends lower in the coagulum.

"*Temperature.*—Thrives best at about 38° C.

"Spores have not been observed.

"*Gas-production.*—Occurs in milk, but not seen in potato cultures.

"*Relation to Gelatin.*—Does not liquefy gelatin.

"*Resemblance.*—Resembles bacterium coli commune and bacillus "d," differing from the former in the character of the colony growth on acid and sugar gelatin and in ceasing to develop in these media after several generations. It differs from bacillus 'd' in this latter respect."

Bacillus "f" of Booker.

"Found in one case of cholera infantum and one case of catarrhal enteritis.

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: It is difficult to distinguish the colony growth from the bacterium coli commune. There is often a difference in the colonies planted at the same time and kept under similar conditions, but it is not very marked nor always the same kind of difference. The tendency to concentric rings is greater in this variety. The colonies develop somewhat better on neutral and sugar gelatin than on acid gelatin.

"Agar: The colonies are large, round, and bluish white. Slightly magnified, a light-yellow color.

"*Stab Cultures.*—Gelatin: The culture is spread over the surface and has a mist-like appearance; in the depth along the line of inoculation is a delicate stalk.

"Agar: Thick, luxuriant, white surface growth, with a well-developed stalk along the line of inoculation in the depth.

"Potato: Bright-yellow, glistening, moist surface, with well-defined borders, and but slightly raised above the surrounding potato.

"*Action on Milk and Litmus Reaction.*—Milk is coagulated into a solid clot in twenty-four hours at 38° C., and

in forty-eight hours is reduced to white or cream color with a thin pink layer on top.

"*Gas-production.*—Gas-bubbles arise in milk cultures, but they have not been observed on potato cultures.

"*Temperature.*—Grows better at 38° C.

"Spores have not been observed.

"*Relation to Gelatin.*—Does not liquefy gelatin.

"*Resemblance.* — It closely resembles bacterium coli commune and Brieger's bacillus in the character of its growth upon different media, but is readily distinguished from both, as is also Brieger's bacillus from the bacterium coli commune, by the following differential test recently made known by Dr. Mall: Yellow elastic tissue from the ligamentum nuchæ of an ox is cut into fine bits and is placed in test-tubes containing water with 10-per-cent. bouillon and 1-per-cent. sugar, and sterilized from one and one-half to two hours at a time for three consecutive days. Into this is inoculated two species of bacteria, one of which is the bacterium under observation, the other a bacillus found in garden earth. The latter bacillus is anaërobic; grows in hydrogen, nitrogen, and ordinary illuminating gas; in the bottom of bouillon; in the depth, but not on the surface, of agar stab cultures, and not at all in gelatin stab cultures. It has a spore in one end, making a knob bacillus. Different species of bacteria—streptococcus Indicus, tetragenus, cholera, swine plague, bacterium lactis aërogenes, bacterium coli commune, Brieger's bacillus, and a number of varieties of bacteria which I have isolated from the fæces—were inoculated with head bacillus into the above-described elastic-tissue tubes. The tubes inoculated with Brieger's bacillus develop a beautiful purple tint, which started as a narrow ring at the top of the culture, gradually extending down-

ward and deepening in color until the whole tube has a dark-purple color. This color-reaction began in five to fourteen days, and was constantly present in a large number of tests. Tubes inoculated with bacillus 'f' gave a much fainter purple color, which was longer in appearing and never became so dark as with Brieger's bacillus.

"Tubes inoculated with the other species of bacteria above mentioned gave no color-change and remained similar to control. Bacillus 'f' also shows a slight difference from bacterium coli commune in coagulating milk and reducing litmus more rapidly, and appears to produce more active fermentation in milk. Like Brieger's bacillus, the gelatin colonies more frequently show a concentric arrangement than those of the bacterium coli commune."

Bacillus "g" of Booker.

"Found in one case of serious gastro-enteric catarrh. It was not in large quantity.

"*Morphology and Biological Characters.* — In morphology, character of growth on agar, gelatin, and potato, it resembles bacterium coli commune.

"*Action on Milk and Litmus Reaction.*—Milk is not coagulated, and milk colored blue with litmus is changed to pink in a few days, and holds this color. These characteristics distinguish it from the bacterium coli commune.

"*Gas-production.* — Not observed in milk or potato cultures.

"*Relation to Gelatin.*—Does not liquefy gelatin."

Bacillus "h" of Booker.

"Found in one case of mild dysentery, not in large quantity.

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: In plain neutral gelatin the colonies resemble those of bacterium coli commune. In sugar gelatin the colonies are white and spread extensively. Slightly magnified, they have a round, dark centre surrounded by a yellow, loose zone with an outer white rim; later the whole colony has a uniform yellow color and is not compact.

"Agar: Colonies are white, round, and large. Slightly magnified, they are brownish yellow.

"*Stab Cultures.* — Nothing characteristic in gelatin and agar.

"Potato culture is yellow, dry, and slightly raised, with well-defined borders.

"*Action on Milk and Litmus Reaction.*—Milk is coagulated into a solid clot in two days at 38° C. Milk colored blue with litmus is changed to pink in twenty-four hours.

"*Gas-production.*—Occurs in milk; not observed on potato.

"*Relation to Gelatin.*—Does not liquefy gelatin."

Bacillus "k" of Booker.

"Found in two cases of cholera infantum and one of catarrhal enteritis.

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: In neutral gelatin the colonies cannot be distinguished from those of bacterium coli commune. In acid gelatin the colonies do not spread so extensively as those of bacterium coli commune, and they have a decided concentric arrangement; a wide white centre surrounded by a narrow, transparent blue ring; and outside of this a white border. Slightly magnified, the colonies have an irregular, yellowish-brown centre,

mottled over with dark spots and surrounded by a light-yellow ring bordered by a brownish-yellow wreath.

"Agar: Colonies are large, round, and bluish white. Slightly magnified, a light-brownish-yellow color.

"*Stab Cultures.*—Gelatin: In sugar gelatin the surface growth is extensive; nearly colorless; and has a rough, misty appearance. In the depth is a delicate growth. In plain neutral gelatin the surface growth is bluish white, thick, and not so extensively spread; the growth in the depth is also thicker.

"Potato culture is moist, dirty-cream color, has raised surface and defined border.

"*Action on Milk.*—Milk becomes gelatinous in twenty-four hours at 38° C., and a solid clot in two days. Milk colored blue with litmus is changed to pink in twenty-four hours, and reduced to white, with a pink layer on top, in two days.".

Bacillus "n" of Booker.

"Found in large quantity, but not the predominating form, in one case of chronic gastro-enteric catarrh (extremely emaciated).

"*Morphology.*—Resembles bacterium coli commune.

"*Growth in Colonies.*—Gelatin: In neutral gelatin the colonies are spread out and have a frosty, or ground-glass, appearance. The centre is blue and border white, but both have the ground-glass appearance. Slightly magnified, the central part is light yellow and the border brown, with a rough, furrowed surface. In acid gelatin the white border is wider and the surface is rougher.

"Agar: Colonies are round, blue, or bluish white, and spread out. Under the microscope they have a light-yellow color.

"*Stab Cultures.*—Gelatin: Has a rough, nearly colorless surface growth, and a thick stalk in the depth along the line of inoculation.

"Agar: Thick white surface growth, with well-developed stalk in the depth.

"*Action on Milk and Litmus Reaction.*—Milk remains liquid and milk colored blue with litmus is changed to pink.

"*Gas-production.*—Not observed in milk or potato cultures.

"*Relation to Gelatin.*—Does not liquefy gelatin.

"Spores have not been noticed."[15]

Bacterium Lactis Aërogenes.

Synonym.—Bacillus lactis aërogenes (Escherich).

Obtained by Escherich (1886) from the contents of the small intestine of children and animals fed upon milk; in smaller numbers from the fæces of milk-fed children, and in one instance from uncooked cows' milk.

Morphology.—Short rods with rounded ends, from 1 to 2 microns in length and from 0.1 to 0.5 micron broad; short-oval and spherical forms are also frequently observed, and under certain circumstances longer rods—3 microns—may be developed; usually united in pairs, and occasionally in chains containing several elements. In some of the larger cells Escherich has observed unstained spaces, but was not able to obtain any evidence that these represent spores.

This bacillus stains readily with the ordinary aniline colors, but does not retain its color when treated by Gram's method.

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[15] Sternberg's "Manual of Bacteriology," 1892.

Biological Characters. — An aërobic (facultative anaërobic), non-liquefying, non-motile bacillus. Does not form spores. Grows in various culture-media at the room-temperature—more rapidly in the incubating oven. Upon gelatin plates, at the end of twenty-four hours, small, white colonies are developed. Upon the surface these form hemispherical, soft, shining masses which, examined

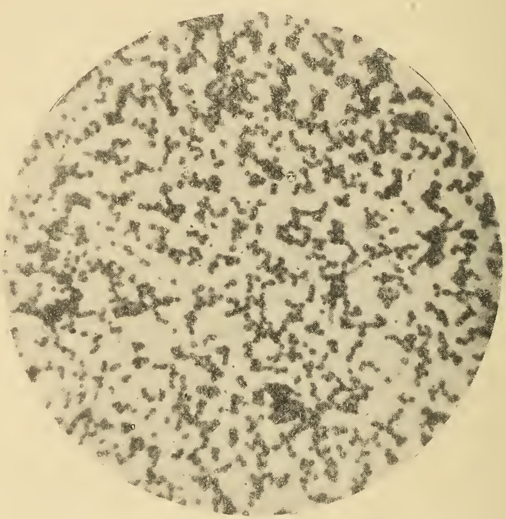

Fig. 10.—Bacterium Lactis Aërogenes.

under the microscope, are found to be homogeneous and opaque, with a whitish lustre by reflected light. The deep colonies are spherical and opaque, and attain a considerable size. In gelatin stick cultures the growth resembles that of Friedländer's bacillus; *i.e.*, an abundant growth along the line of puncture and a rounded mass upon the surface, forming a "nail-shaped" growth. In old cult-

ures the upper part of the gelatin is sometimes clouded, and numerous gas-bubbles may form in the gelatin. Upon the surface of nutrient agar an abundant, soft, white layer is developed. Upon old potatoes, in the incubating oven, at the end of twenty-four hours a yellowish-white layer, several millimetres thick, is developed, which is of paste-like consistence and contains about the periphery a considerable number of small gas-bubbles; this layer increases in dimensions, has an irregular outline, and larger and more numerous gas-bubbles are developed about the periphery, some the size of a pea; later the whole surface of the potato is covered with a creamy, semifluid mass filled with gas-bubbles. On young potatoes the development is different; a rather luxuriant, thick, white or pale-yellow layer is formed, which is tolerably dry and has irregular margins; the surface is smooth and shining, and a few minute gas-bubbles only are formed after several days.

Pathogenesis.—Injections of a considerable quantity of a pure culture into the circulation of rabbits and of guinea-pigs give rise to a fatal result within forty-eight hours.

In his first publication relating to "the bacteria found in the dejecta of infants afflicted with summer diarrhœa," Booker has described a bacillus which he designates by the letter "b," which closely resembles bacillus lactis aërogenes and is probably identical with it. He says:—

"*Summary of Bacillus 'b.'*—Found nearly constantly in cholera infantum and catarrhal enteritis, and generally the predominating form. It appeared in larger quantities in the more serious cases. It was not found in the dysenteric or healthy fæces. It resembles the description of the bacillus lactis aërogenes, but the resemblance does not

appear sufficient to constitute an identity, and, in the absence of a culture of the latter for comparison, it is considered a distinct variety for the following reasons: Bacillus 'b' is uniformly larger, its ends are not so sharply rounded, and in all culture-media long, thick filaments are seen, and many of the bacilli have the protoplasm gathered in the centre, leaving the poles clear. There is some difference in their colony growth on gelatin, and in gelatin stick cultures bacillus 'b' does not show the nail-form growth with marked end-swelling in the depth. In potato cultures the bacillus lactis aërogenes shows a difference between old and new potatoes, while bacillus 'b' does not show any difference.

"Bacillus 'b' possesses decided pathogenic properties, which were shown both by hypodermic injections and feeding with milk cultures."

CHAPTER IX.

Colostrum.

Colostrum is found in the breast of a woman several hours after birth. It resembles milk, but is a much thinner fluid. It is always the forerunner of a healthy normal secretion of breast-milk, which usually appears on the third day after the birth of the infant.

Colostrum is the earliest milk, very thin and watery

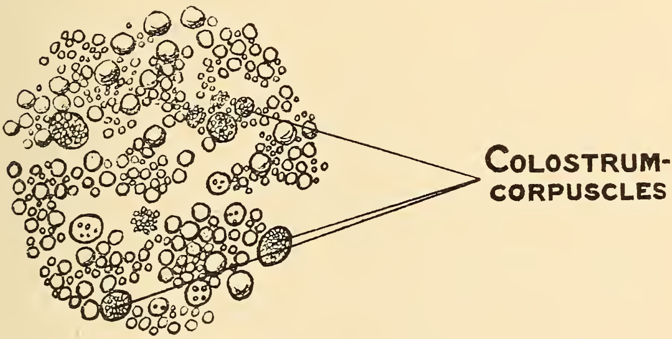

Fig. 11.—From a Drop of Milk on the Third Day after Delivery, kindly Furnished by Dr. H. L. Collyer, showing Colostrum-corpuscles. The specimen drawn by Dr. Julian W. Brandeis. (Zeiss Ocular 4, dd Lens.)

in color, very rich in salts, with decided purgative properties, saving all useless castor-oil, honey, and butter and all sugar-water, with which mothers and nurses take such delight in experimenting with.

According to Baginsky, colostrum contains large quantities of serum-albumin, is also very rich in fat and

colostrum-corpuscles, and a large quantity of salts. The last *two ingredients* are supposed to be the cause of the *laxative action* of the colostrum.

Immunity by Breast-milk.

It is a well-known fact, and one that has been brought out most prominently by Brieger and Ehrlich and Baginsky, that immunity can be conferred on a child by nursing the milk of its mother. This question has also been studied with reference to conferring immunity in infectious diseases, and H. Neumann has found that immunity can be conveyed to an infant by the agency of breast-milk.

The Two Mammary Glands.

The two mammary glands of the same woman may yield somewhat different milk, as shown by Sourdat and later by Brunner. Also the different portions of milk from the same milking may have different compositions. The first portions are always poorer in fat (Parmentier, Peligot, and others).

According to l'Heritier Vernois and Becquerel, the milk of blonds contains less casein than that of brunettes: a difference which Tolmatscheff could not substantiate. Women of weak constitutions yield a milk richer in solids, especially in casein, than women with strong constitutions.

According to Vernois and Becquerel, the age of the woman has an effect on the composition of the milk, so that we find a greater quantity of proteids and fat in women 15 to 20 years old and a smaller quantity of sugar. The smallest quantity of proteids and the greatest quantity of sugar are found at 20 or from 25 to 30 years of

age. The milk with the first-born is richer in water—with a proportionate diminution of the quantity of casein, sugar, and fat—than after several deliveries. The influence of menstruation seems to slightly diminish the milk-sugar and to considerably increase the fat and casein.

Witch's Milk.

Witch's milk is the secretion of the mammary glands of newborn children of both sexes immediately after birth. This secretion has, from a qualitative stand-point, the same constitution as milk, but may show important differences and variations from a quantitative point of view. Schlossberger and Hauff, Gubler and Quevenne, and von Gesner have made analyses of this milk, and give the following results: 10.5-28 p. m. proteids, 8.2-14.6 p. m. fat, and 9-60 p. m. sugar.

The newborn human infant almost constantly secretes a fluid in the mammæ, and adult males have not only secreted milk, but that in abundance enough to suckle. Females, also, both human and animal, occasionally secrete milk without having been previously pregnant. With regard to the milk secreted by infants, there is some doubt about its real nature. Kollicker does not view it as a true milk, but considers its appearance connected with the formation of the mammary glands.

Sinety, on the other hand, upon anatomical grounds considers it a true lacteal secretion. It probably is a sort of imperfect milk, loaded with leucocytes, and this is the more likely as Vollard[16] notices that it frequently ends in abscess.

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[16] "Traité des Maladies des Enfants nouveau nes," third edition, 1837, p. 717.

Schlossverger gives an imperfect quantitative analysis of a sample of milk obtained by squeezing the breasts of a newborn infant, a male. In the course of a few days about a drachm was obtained. The following was the result of the analysis:—

Water	96.75
Fat	0.82
Ash	0.05
Casein, sugar, and extractives	2.83
Sugar-reaction	strong.

The most complete analysis we possess of such milk is by von Gesner:—

Milk-fat	1.456
Casein	0.557
Albumin	0.490
Milk-sugar	0.956
Ash	0.826
Water	95.705
Total solids	4.295

Joly and Filhol have recorded the case of an old lady, 75 years of age, who suckled successfully her grandchild. Similar instances have been recorded in dogs, and we fortunately possess one or two analyses which show that the fluid is certainly milk. Thus, Filhol and Joly give the following analysis of the milk derived from a bitch which had no connection with a male:—

Specific gravity	1.069
Total solids	29.00
Fat	2.20
Sugar	0.32
Albumin	23.20

The ash, on analysis, gave the following percentage:

Chloride of sodium	65.10
Chloride of potassium	3.88
Calcic phosphate	27.75
Sodic phosphate	1.40
Sodic carbonate	1.87
Traces of magnesia and other phosphates.	

Men Suckling Children.

Men before now have suckled children. Humboldt relates the case of Francisco Lozano, whom he saw, and whose case he carefully investigated; and it appears established that this man did secrete from his breasts a nutrient fluid, on which his infant son lived for many months; it is said, indeed, a whole year. The curious in such matters may consult the references given farther on.[17]

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[17] 1. "Untersuchung der sogenannte Hexenmilch." J. Schlossberger, Annalen der Chemie und Pharmacie, B. 87, 1852. 2. Robert Bishop of Cork: letter concerning a man who gave suck to a child. Phil. Trans., 1741, No. 461, page 813, etc.

CHAPTER X.

Breast-milk.

According to Pfeiffer, human milk contains, several days after the birth of the baby, a large quantity of albumin, salt, and a small quantity of fat. He also found

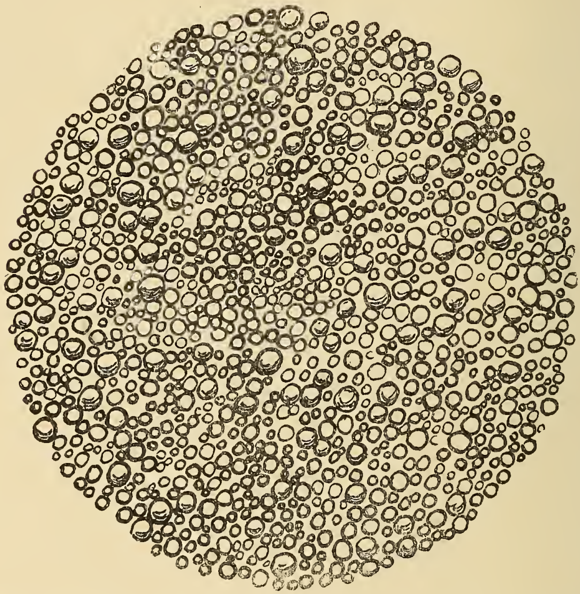

Fig. 12.—This Illustration was Drawn by Dr. J. W. Brandeis from a Drop of Breast-milk Taken from a Wet-nurse Employed in the Author's Family. It Represents an Elegant Emulsion of Evenly-Divided Fat-globules. Note the Regularity of their Size.

that, the longer the period of nursing, the smaller the quantity of albumin, which, in the eleventh month, sinks

quite low. There is also a *decrease in the quantity of salts*, whereas the amount of sugar steadily increases. The fat varies constantly. According to Johannessen, the quantity of albumin in the first six months is 1.192 per cent.; in the next six months 0.989 per cent.; and at the end of the year 0.907 per cent.

Breast-milk varies according to the length of time that it remains in the breast, and also the length of the nursing period; so it has been shown that the first milk taken at the beginning of the nursing act is the poorest in nutrient value, whereas the last milk is richest in fat. The longer the milk remains in the glands of the breast, the more solid substances of the same will be absorbed; so that only a watery solution remains. If sucking is commenced, this stimulation soon changes the character of this watery milk, so that normal milk will soon be secreted. Forster studied the chemical examination of the first, middle, and the last portions of milk from a nursing woman, with the following result:—

In one hundred parts he found:—

First Portion of the Nursing Act.

Water	90.24
Nitrogenous substances	1.13
Fat	1.70
Sugar	5.56
Ash	0.46

The quantity examined was 33.1 grammes.

Second Portion (during the Nursing).

Water	89.68
Nitrogenous substances	0.94
Fat	2.77
Sugar	5.70
Ash	0.32

The quantity examined was 33.1 grammes.

Third Portion (at the End of the Nursing Act).

Water	87.50
Nitrogenous substances	0.71
Fat	4.51
Sugar	5.10
Ash	0.28

The quantity examined was 37.3 grammes.

From a study of the foregoing tables we find a decrease of nitrogenous substances during the course of the nursing, that the fat constantly increases, and the milk-sugar remains constant. Thus, it is apparent that, in order to submit a *specimen of breast-milk* to a *chemical examination,* it is necessary to stimulate the secretory functions of the mammary glands by putting the child to the breast at least two minutes; thus an even milk can be procured. If this rule is overlooked, then we will find variations in the chemical components of milk which might otherwise be entirely different. The most recent chemical analysis of breast-milk shows that in a hundred parts there are

Solids	11.5
Liquids	88.5

Of the solid constituents there is

Casein	1.2 to 1.03
Albumin	0.5
Fat	0.8 to 4.07
Milk-sugar	6.0 to 7.03
Ash	0.2 to 0.21

The above is the chemical examination of a good average breast-milk. I have previously shown, however, that not only does the milk vary in different women, but it also varies in the same woman during one single nursing act.

The albuminoids of milk consist of real casein, lact-albumin, globulin. and opalisin. This latter body has only recently been discovered by A. Wroblewski, and more recently by Schlossmann.

Phosphorus exists in milk as nuclein-phosphorus. Wittmaack has demonstrated the fact that the phosphorus in woman's milk exists as an organic nitrogen compound in the casein.

Lecithin contains a larger quantity of phosphorus in woman's milk than in cows' milk, according to the examination of Stolasa.

The specific gravity of breast-milk varies from 1.026 to 1.036.

SPECIMEN OF BREAST-MILK FOR CHEMICAL EXAMINATION.

After the third, possibly the fourth, day the average healthy woman secretes milk that gradually becomes normal in quality and quantity, depending on her general condition. It is usual for an infant to lose some weight during its first week of life, owing to various physiological changes, added to which is, no doubt, the deficiency in the quality and quantity of its food. It is a safe plan, and one that I have always urged, if at all possible, to send a specimen of breast-milk to a chemist and submit the same to a chemical analysis. In some women a specimen can be examined when the baby is one week old; in others it is better to wait until the end of two weeks. We then would have a proper working basis, and know just how much fat, carbohydrate (sugar), and albuminoids —including proteids—we are feeding; noting the weight of the child, its sleep, its digestion, color and frequency of its stools; we can easily see in one week how much the

infant has gained in weight, and its general condition. To take a specimen, it is advisable to have all utensils absolutely clean; hence the following plan would be suggested: Boil an ordinary one- or two- ounce bottle in water, to which a piece of baking soda has been added, for about one-half hour. Then place the bottle in plain water and boil again for a half-hour. Then turn the bottle upside down, and allow it to drain and dry. In this manner we can completely sterilize the inside of the bottle, which is very vital to avoid contamination.

Withdraw a sample of breast-milk by taking a breast-pump. One of which has served the author very well is known as the Florence breast-pump, and has a glass mouth-piece. (See illustration, Fig. 15.) Another breast-pump is an English breast-pump, having a rubber bulb; compressing this bulb, we can suck about an ounce or more in from five to ten minutes. This milk is to be poured in the bottle, and well corked, and set in a refrigerator, but not on the ice. Milk will keep for many hours in this way. My plan has been to inform the chemist the day previous to submitting the sample, so that it can be withdrawn from the breast early in the morning—at about 8 A.M.—and sent to the laboratory at once. The result of the analysis can be received on the evening of the same day or the following day in all instances. A point worth noting is that the very first milk—known as the foremilk—should not be used, but the infant should be allowed to suck at the breast for about two minutes before pumping the sample. After this the breast-pump should be applied for five minutes to procure the so-called middle milk for examination; then the infant can again be put to the breast to finish the so-called end of nursing or to suck the strippings.

Human Milk.	Fat.	Proteids.	Sugar	Ash.	Authority.
Normal Milks.					
Average .	2.90	3.07	5.87	0.16	A. W. Blythe.
Average	3.68	1.70	7.11	0.20	Marchand.
Average	2.67	3.92	4.37	0.14	Vernois & Becquerel.
Average .	3.52	2.01	5.91		Hammarsten.
14 analyses from same woman	2.53	3.42	4.82	0.23	Simon.
Mean of 6, aged 23-33 years	3.82	2.04	5.93	0.42	H. Gerber.
Average .	3.55	1.52	6.50	0.45	Chevalier & Henry.
From woman aged 18	3.20	2.39	6.83	0.29	J. Bell.
From woman aged 33	2.99	2.51	6.51	0.30	J. Bell.
4 days after delivery .	4.30	3.53	4.11	0.21	Clemm.
9 days after delivery .	3.53	3.69	4.30	0.17	Clemm.
12 days after delivery	3.34	2.91	3.15	0.19	Clemm.
Average of 84 samples .	4.13	2.00	6.94	0.20	Leeds.
Average of 107 samples .	3.78	2.09	6.21	0.31	König.

CHAPTER XI.

Breast-feeding.

During the first month feed every two hours, but never oftener. During the second month, every two and a half to three hours.

Never disturb a child from its sleep to be nursed; so that the rule should be to leave the baby rest as long as it appears satisfied. This rule applies to healthy children only. In sickness special feeding rules are required. If the child thrives, gains in weight, then it is advisable in the interest of the mother and child to have an interval of from seven to eight hours at night; thus Bouchut advises feeding between 10 and 11 at night and commencing the morning meal at 6 A.M. If the child is restless, then turn the child from side to side; in other words, changing its position and giving it 1 or 2 teaspoonfuls of boiled water will frequently satisfy it and prolong its sleep.

Time for Feeding.

From Birth until 1 Month Old.	At 1 Month until 2 Months Old.	2 to 4 Months Old.	4 to 6 Months Old.	6 to 9 Months Old.	9 Months until 1 Year Old.
6 A.M.	6 A.M.	6 A.M.	6 A.M.	6 A.M.	6 A.M.
8 A.M.	9 A.M.	9 A.M.	9 A.M.	9.30 to 10 A.M.	10 A.M.
10 A.M.	11 A.M.	12 Noon.	12 Noon.	1.30 to 2 P.M.	2 P.M.
12 Noon.	1 P.M.	3 P.M.	3 P.M.	5.30 to 6 P.M.	6 P.M.
2 P.M.	3 P.M.	6 P.M.	6 P.M.	9.30 to 10 P.M.	10 P.M.
4 P.M.	5 P.M.	9 P.M.	9 P.M.		
6 P.M.	7 P.M.	12 Midnight.			
8 P.M.	9 P.M.				
10 P.M.	11 P.M.				
12 Midnight.					

The first three or four days after birth require *special* feeding methods:—

On the day of the birth, the exhaustion of the mother and presence of colostrum, besides the normal deficient quantity of food in the breast, demand large intervals of rest; thus for the first three days (unless the milk-supply is profuse) putting the infant to the breast once every six hours would be ample; if, however, the supply of milk is ample, then we can follow the table given above and nurse the infant every two hours.

SUGGESTIONS FOR BREAST-FEEDING.

The mother or wet-nurse should always sit upright, be it at night or during the day, while nursing the infant.

Danger of Suffocation.—A great many cases are on record where the mother or wet-nurse has fallen asleep while nursing, and smothered the child. For this reason it is important that the infant should sleep in its own crib or bed, and should never sleep with its mother or nurse.

Shall an Infant Receive but One or Both Breasts for One Meal?—This depends on the infant's appetite. Some infants appear satisfied after nursing from one breast, and will let the nipple go and fall asleep. Light tapping on the cheeks of the infant will awaken it, or the withdrawal of the nipple from the infant's mouth will frequently arouse the child to continue its nursing. If, however, an infant will not renew its nursing, and still continue to sleep, and if the infant has nursed steadily for ten minutes, then the sleep should not be disturbed.

Length of Time for Nursing.—A good plan is to note the time when the nursing act commences and stops. No infant should nurse longer than 20 minutes, whereas fre-

quently 10 minutes or 15 minutes will suffice. If an infant nurses more than 20 minutes, say 30 or 40 minutes, then we may be sure that the breast-milk is deficient in quantity, and a specimen should at once be submitted for a proper chemical examination.

Mixed Feeding.

When there is a deficiency in the quantity of breast-milk, but the quality is good, then it is advisable to feed the infant alternately with breast-milk and bottle-milk. At the same time, it is advisable to direct attention to the mother's general condition, and see if we cannot tone her up, and thus improve both quality and quantity of her milk. Frequently a subnormal or anæmic condition requires iron; in other cases a day's outing to the sea-shore or to the country, with moderate exercise, will stimulate and increase the flow of milk. It is well to try some galactagogues. Among them the author has found an albumin diet (meat, milk, and eggs) and a preparation known as nutrolactis in tablespoonful doses before meals to have acted very well in some cases. Grandin and Jarman, in their text-book on obstetrics, recommend the strong infusion of galega officinalis when the flow of milk is scant. This is to be ordered in tablespoonful doses three or four times a day. Every drop of breast-milk is so precious that no infant should be deprived of it, and wise is the physician who will insist on giving all the breast-milk when there is deficient lactation, and supplying the deficiency by giving a proper diluted milk- or cream- mixture, adapted for the age and weight of the infant.

Do Drugs Taken by a Nursing Woman Affect the Baby During the Nursing Period? — Physiological experiments

have frequently demonstrated the fact that a great many drugs can be given to an infant through its mother's milk: thus, opium and morphine and narcotics in general do affect the nursling when the drugs are taken by the mother. Baginsky calls attention to this fact in his text-book on "Diseases of Children": "Alcohol, when taken by the mother, is transmitted through the milk, but not in very large quantities. The following is a list of drugs which have been found in milk: The purgative principles of rhubarb, senna, and castor-oil; the metals antimony, arsenic, iodine, bismuth, lead, iron, mercury; the volatile oils, like copaiba, garlic, and turpentine; also salicylic acid, and the iodides and bromides." Do not give cocaine, chloral, atropine, or hyoscyamus. Care to be used with the following: Digitalis, antipyrin, and ergot. An unpleasant flavor can be imparted to the breast-milk by the mother or wet-nurse eating onions, turnips, cauliflower, or cabbage.

Microbes in the Milk of Nursing Women.

Ringel[18] examined the milk of 25 women, 12 of whom were healthy. With minute precaution to insure accuracy, he found the milk sterile in only 3 cases; he obtained the white staphylococcus in 17, the yellow in 2, the two together in 1 case, and in 2 instances he found the white staphylococcus together with the streptococcus. As the microbes could not be due to genital infection, the idea was suggested that they might come from the

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[18] Münch. med. Wochenschrift, No. 27; British Gynæcological Journal, xxxvi; Brooklyn Medical Journal, August, 1894.

child's mouth, the white staphylococcus having been, in fact, found on the child's tongue. But having examined the milk of a woman who had not been suckling, but whose nipples had been disinfected, Ringel still found the staphylococcus.

Sterility of Human Milk.

Honigmann finds that human milk obtained with all antiseptic precautions from 73 breasts of 64 nursing women was only sterile, when duly cultivated, in 4 cases. In the remainder staphylococcus albus was present, and in 44 cases the staphylococcus aureus; while in 3 instances other bacteria—a bacillus and a sarcina—were found. The number of germs varied from 1 to upward of 9000 in a cubic millimetre. These observations are of interest in reference to the occurrence of thrush in children, to the origin of which they may furnish a clew, and also to the liability that children, while suckling, present to suppuration after wounds accidentally or intentionally inflicted. (*Lancet.*)

Fat-globules.

Woman's milk has larger fat-globules than cows' milk. Their number, according to Bouchut, is 1 to 2 millions in 1 cubic centimetre. It has less inclination to turn acid; therefore it does not coagulate distinctly.

Additional Foods During the Nursing Period.

Flour-Ball Feeding.—When an infant nursing at the breast is six months old certain additions to the food can safely be made; thus, for example, the

white of a raw egg can be given every second day, and on the alternate day several teaspoonfuls of a meat-soup (beef or chicken) in which barley, farina, or sago has been boiled and strained. This method of feeding can be kept up until the child is seven or even eight months old, and then a small piece of zwieback can be allowed every day. As this is hard, children like to nibble on it, for it seems to soothe their gums. If the bowels are in a good condition, then a few teaspoonfuls of a very light wheat-flour ball can be given every few days. Flour ball can best be made by following the directions given by Dr. Edwin Rosenthal (paper read before the Pennsylvania State Society, May 18, 1898, entitled "Some Points on Infant-feeding"); he says: "I use the following formula, and I can claim as much good results therefrom as from any form of modified home-made food. It is known as the flour-ball food, commercially imperial granum. It is made as follows: Plain wheat-flour is boiled in a bag for five hours, then dried, broken open, the rind rejected, and then grated into a powder. I take of pure milk, mixed and scalded, 1 pint; of sterile water, 1 pint; of the boiled flour, a heaping tablespoonful, a bit of cinnamon-bark (sometimes to give some flavor with certain children), and a pinch of common table-salt. The milk is placed on the fire and heated; the flour is rubbed to a fine paste with the water, and then added to the milk. The cinnamon is added, and then it is brought to the boiling-point, taken from the fire, the salt added (not sufficient to taste), and the whole is then placed on the ice. It is then heated again when used. Two ounces every two hours is given to a child one month old. It is increased $1/2$ ounce every month, while the water is reduced 1 ounce every month. The milk is added to keep the quantity up to the 2 pints.

I have with this method seen some very surprising results, and feel no hesitancy in recommending it."

The Addition of Hydrochloric Acid to Food.—The indiscriminate use of dilute hydrochloric acid is a practice that is to be condemned. We know that hydrochloric acid passes through the body unchanged, and in being excluded by the kidneys frequently irritates the same. A point to note is that HCl is formed in the stomach from the chlorides in the circulation of the blood. It appears, therefore, quite plausible to add salt to the infant's food (ordinary table-salt: NaCl), which is likely to be transformed into HCl in the infant's stomach.

The Feeding of Sick Children.—The method of feeding here is entirely different from feeding in health. No definite rules can be laid down as to the quantity or the quality, or the interval required for feeding; for example, if an infant suffering with dyspepsia will vomit, and have large, cheesy curds in the stools, and have anorexia, such an infant requires food that is far more diluted with water than heretofore. If, let us say, an infant, two months old, suffer with dyspeptic disturbance, and receives 2 parts of milk and 3 parts of water, such an infant should be given 1 part of milk with 3 parts of water, to see if the dyspeptic condition cannot be modified. If no improvement is noted after several days of such feeding then it is wise to substitute barley-water instead of plain water, and thus see if the digestibility of the casein cannot be improved. If, however, no improvement is noted, then a good plan is to resort to predigested foods. It is in this class of cases that peptonized foods are so advantageous; but, if milk is badly borne, then it should be diluted with dextrinized gruels.

The Diet of a Nursing Mother.

Immediately after the birth of the child the exhausted condition of a woman following labor will certainly call for rest; hence sleep is imperative, after which some form of stimulation is required. This can best be accomplished by giving at intervals of several hours good wholesome food, as broth of chicken, or beef-broth, weak tea, or strained gruel. It is unnecessary to state that each woman's case and her former habits must be taken into consideration; and thus, if the labor has been normal, the nourishment will certainly stimulate the flow of milk. Great care, however, must be given to the usual irritable stomachs in this condition, and, if warm liquids are not well borne, then cold drinks, like buttermilk, koumiss, matzoon, or iced tea, should be employed. In some instances ice-cream will aid nutrition and allay gastric irritability. If the pelvic condition is normal, then it is wise not to give solid food for the first three days, but, rather, stimulate the milk-glands by giving meat-broths, farinaceous gruels, and by all means milk. Zwieback soaked in milk or in tea is highly nutritious and easily digestible. Other nutritious foods are calf's-foot jelly and chicken-jelly.

After the third day—if the pelvic organs are normal—it is wise to consider the action of the bowels. If the bowels have not moved by this time, then buttermilk added to the diet or some stewed prunes or baked apples or stewed peaches, or grapes, will aid in establishing a movement of the bowels.

If the milk is scanty and the bowels have not acted, then the best remedy is a large tablespoonful of castor-oil, modified to suit the taste by the addition of either orange-juice or lemon-juice, or by adding several drops of the

ordinary spirit of peppermint. After the bowels have been evacuated and the general condition warrants it, then a diet consisting of the following is indicated:—

Breakfast, 7 to 8 a.m.

Hominy and Milk.
Farina and Milk.
Rice and Milk.
Oatmeal and Milk.
Germea and Milk.
Cream of Wheat and Milk.
Some Stewed Prunes, Figs, or Peaches.
Stewed Apples.
Oranges.
Grapes.
Soft-Boiled Eggs.
Poached Eggs.
Eggs on Toast.
Coffee and Milk.
Tea and Milk.
Cocoa and Milk.
Toast and Butter.
Stale Bread (2 days old), with Butter.

I do not advise meat nor fish in the morning, unless the nursing mother has always been accustomed to this form of diet.

Lunch, 12 to 1 p.m.

Some soup, made from meat, either veal, beef, mutton, lamb, or chicken, containing also some rice, barley, farina, sago, or hominy; it should not be highly seasoned, and should not be strained.

Fish, boiled or fried, and all shell-fish, particularly oysters, are very nutritious during the milking period.

If the appetite warrants it, then a piece of steak or chop, roast beef, chicken (white meat only), or raw chopped meat, with bread and butter, is very nutritious.

Some fruit.

Evening, 6 to 7 p.m.

A bowl of Oatmeal Gruel.
Some Oysters (stewed).
A drink of Milk.
Farina Pudding.
Rice Pudding.
Cornstarch Pudding.
Junket.
Cup of Tea.
Eggs, if desired.
Meat, if in the habit of eating it in the evening.

For Thirst. — Cool, filtered water or the alkaline waters, like Seltzer and Apollinaris.

If the milk is scanty, the flow can be stimulated by drinking a cup of hot broth, made from beef, chicken or veal, lamb or mutton, several minutes before putting the child to the breast.

Alcoholic Drinks.—If a woman is in the habit of drinking beer or wine, then it is unwise to discontinue the use of alcoholics in moderate quantities, while she is nursing. I have seen a great many women whose flow of milk was scant, that immediately secreted an abundance of milk after partaking of a glass of beer or ale or porter with their meals for several days. Beer has a decided laxative effect, and this in itself is rather an advantage for those nursing mothers having a tendency to constipation. So, my rule, therefore, would be to insist on abstinence from wine and beer unless the patient has been in the habit of taking it formerly.

THINGS TO BE AVOIDED BY A NURSING WOMAN.

Onions.
Garlic.
Cabbage.
Powerful Salts (Rochelle, Glauber, Epsom).
Ethereal Oils.
Large quantities of potatoes.
Butter and Fat moderately.
Candies and too much Sweets.

CHAPTER XII.

Wet-nurse.

If the infant's own mother cannot nurse her child, then we can and should try to secure a wet-nurse.

The wet-nurse must be carefully examined, as well as her child, for the presence of syphilis. I beg to refer to a short paper on this subject, published in the *American Medico-Surgical Bulletin* in January, 1894.

1. Never have a baby fed by the milk of its mother if the latter suffer with general debility or tuberculosis. Extremely nervous mothers should not nurse their babies.

Syphilitic babies (hereditary) can only be nursed by their own mothers, owing to the risk of infecting the wet-nurse.

Very frequently the life of the child is dependent on its being nursed by its mother in syphilis.

(*a*) The return of menstruation is no contra-indication to the continuation of nursing.

(*b*) The moment a woman is pregnant nursing should be stopped.

(*c*) Children should not be nursed at night unless for some special reason.

(*d*) Weaning should take place gradually, and only in the eighth to the tenth month.

(*e*) It is understood that weaning should not be commenced during the hot summer weather.

The main factor in determining the time of weaning is "weighing." Children must be weaned when, although in perfect good health, they remain below normal weight.

(*f*) Prolonged nursing will induce rachitis.

2. If, for various reasons, a child cannot be nursed by its own mother, we then resort to the wet-nurse.

(*a*) She must be carefully examined as to her physical condition; tuberculosis, all chronic disorders and diseases would prevent proper nursing. Hereditary nervous troubles, epilepsy, or syphilis would exclude nursing.

(*b*) It is a good point to try to procure a wet-nurse suckling a child about as old as the one we wish her to nurse, although it is quite common to find nurses who have older children than the one they wish to nurse and to find the latter doing well.

(*c*) The proof of the usefulness of the wet-nurse is the condition of the baby after some time. If the child thrives, it will increase in weight. Hence scales must be frequently used.

DIET (WET-NURSE).

The diet given for a nursing mother can also be used as a guide in choosing the diet for a wet-nurse. The greatest care, however, must be bestowed on the

Manner of Living.—If a wet-nurse was a former servant, or worked out-of-doors and is suddenly taken into this new mode of life and given charge of a baby, she must have proper exercise, or else such wet-nurse will very soon secrete milk which will be totally unfit for an infant, and, as a result, the child will probably have severe colic and irregular, cheesy stools; will vomit excessively; and will not gain in weight sufficiently. It is, therefore, important to try and adapt a wet-nurse to the same condition as existed prior to her pregnancy; so that both her manner of living and, chiefly, her diet shall not be different.

Proper Rest.—To be equal to her task a nurse must be given plenty of sleep, if it is at all possible.

Adriance, in the *Archives of Pediatrics*, says:—

1. Excessive fats or proteids may cause gastro-intestinal symptoms in the nursing infant.

2. Excessive fats may be reduced by diminishing the nitrogenous elements in the mother's diet.

3. Excessive proteids may be reduced by the proper amount of exercise.

4. Excessive proteids are especially apt to cause gastro-intestinal symptoms during the colostrum period.

5. The proteids, being higher during the colostrum period of premature confinement, present dangers to the untimely-born infant.

6. Deterioration in human milk is marked by a reduction in the proteids and total solids, or in the proteids alone.

7. This deterioration takes place normally during the later months of lactation, and, unless proper additions are made to the infant's diet, is accompanied by a loss of weight, or a gain below the normal standard.

8. When this deterioration occurs earlier, it may be the forerunner of the cessation of lactation, or well-directed treatment may improve the condition of the milk.

Methods of Changing the Ingredients in Woman's Milk.

Rotch gives a condensed table for these changes as follows:—

To Increase the Total Quantity.—Increase the liquids in the mother's diet, especially milk (malt-extracts may be helpful), and encourage her to believe that she will be able to nurse her infant.

To Decrease the Total Quantity.—Decrease the liquids in the mother's diet.

To Increase the Total Solids.—Shorten the nursing intervals, decrease the exercise, decrease the proportion of liquids, and increase the proportion of solids in the mother's diet.

To Decrease the Total Solids.—Prolong the nursing intervals, increase the exercise, and increase the proportion of liquids in the mother's diet.

To Increase the Fat.—Increase the proportion of meat in the diet.

To Decrease the Fat. — Decrease the proportion of meat in the diet.

To Increase the Proteids.—Decrease the exercise.

To Decrease the Proteids.—Increase the exercise up to the limit of fatigue for the individual.

It is wise in all cases of *disturbed lactation*, whether in maternal or wet- nursing, to make efforts in accordance with these rules to produce a milk that is suitable for an infant who is not thriving, before changing to any other method of feeding.

Wet-nursing.

It is an established fact that the best possible food for an infant is breast-milk. Where the mother of an infant is prevented from nursing her child, the next thing to be considered is wet-nursing. That nursing a child is an advantage to the mother is a well-known fact, inasmuch as it influences the contraction of the uterus and stimulates the circulation. Contrary to the belief that nursing a child is detrimental, and contra-indicated in women whose lungs are weak and who have a tendency to the development of tuberculosis, it does them no harm, and, on the contrary, seems to do them good. This statement is borne out by the experience of Dr. Heinrich

Munk, of Karlsbad, Austria, a specialist for diseases of women.

In Austria the State has public institutions for lying-in women. They are kept there and confined *gratis*, and remain about fourteen days. They are admitted into these hospitals in the last months of pregnancy. Vienna usually has about 300 women on hand. Prague constantly has 100 women in this condition, who are utilized for the purpose of instruction to physicians and midwives.

In Prague there are about 3000 women confined annually, and these women are put into the foundling-asylum. There they remain until they procure a place as a wet-nurse or as long as their services are needed in the asylum. When wet-nurses are taken from the foundling-asylum, it is a frequent occurrence to have those remaining therein nurse at least two children, and frequently, three, at one time. In this manner they dispense gradually with these wet-nurses without hurting the remaining children. Many children die, some of them intrapartum in operative confinements, and the women (mothers of such children) are then utilized for wet-nursing. It is a rule to keep the children in the asylum until they have attained a little over four kilogrammes (about 9 pounds), and are then put out for further feeding (artificial feeding), for which the city pays about 12 florins a month ($5.00). The children remain usually until they are six years old, and are then given back to their own mothers. Many of these children die, others are adopted by those who have reared them, but the greater portion are taken back by their own mothers. In Vienna there are about 10,000 confinements annually in the public institution. There are a great many cities in Austria—like Innsbruck-Olmutz, Brunn, Linz, and Klazenfurt—where there are

at least 200 confinements annually. In Vienna a wet-nurse receives 30 florins per month, for which she is sent (railroad expenses paid) to whomever requires her services. She is taken on trial for fourteen days to see if she is adapted for her place. A wet-nurse can be procured by sending a telegram and a money-order any day during the year. The customary wages are from 12 florins upward per month. Each wet-nurse is carefully examined by the professor before she is sent away. A great many families do not care to take a wet-nurse from an asylum, as they are usually women in the lowest walks of life, and prefer, therefore, to take a woman who has been married. For this purpose there are wet-nurse agencies, duly licensed. These will supply wet-nurses, and usually take orders in advance; thus a wet-nurse may be reserved. Such wet-nurses cost much more, and those from one special region—Iglau in Mahren—receive from 20 to 50 florins monthly.

The empress took for her own use a wet-nurse from Iglau (a married woman), and the Princess of Bulgaria took a wet-nurse from Iglau for her last child. Not only Iglau, but the whole region, is renowned for its excellent quality of wet-nurses. The Bohemian and Mahren nurses have very good mammæ. They seem to love those children intrusted to them.

While it is a rule that a wet-nurse should be taken for a baby of the same age as that of her own, frequently wet-nursing of an infant at birth by a wet-nurse whose baby is three months old has not been followed by any bad results.

In New York we are at a decided disadvantage regarding wet-nurses. As no licensed agencies exist, a few people having so-called influences procure wet-nurses by

friendship, or something similar, from superintendents and house physicians where obstetrical work is done.

Thus we find ourselves at the mercy of some people who traffic in wet-nurses for a fee, usually five dollars, and who do not stop at anything to attain their own selfish ends.

Time and again have I sent for a wet-nurse to an agent who, instead of giving me a healthy wet-nurse, tried to induce me to use women having colostrum-milk for an infant in which such milk would have proved disastrous.

In another instance, only recently, I procured a wet-nurse from an agent who sent me one 17 years old that had had a premature birth, "evidently an abortion," whose milk was typical thin water, with here and there a fat-globule, when examined under the microscope.

At other times some of the finest specimens of wet-nurses have also been procured from the same agent.

It is a pity that we have no municipal control for what the writer considers one of the most valuable forms of adjuncts to our maternal feeding, and in the same manner such control would regulate the supply to such unlimited number that modern arrogance on the part of the wet-nurse would probably disappear.

The prices paid in New York are from twenty to thirty dollars per month and board, and this price prohibits many an infant from securing the benefits of Nature's food. Let us hope for municipal regulation.

Weaning, and Feeding from One Year to Fifteen Months.

Weaning should take place gradually between the eighth and tenth months. In some instances it is ad-

visable to commence weaning a child much sooner. For example, when there is a deficiency in the supply of milk or owing to ill health of the infant's mother. This I have already mentioned in my section on "Mixed Feeding."

Weaning is imperative when the infant's mother is pregnant, although it is advisable to use great caution if it occur in midsummer. In case of this kind the better plan would be to have a specimen of the breast-milk examined by a chemist, and, if the same be found deteriorated in quality, then the judgment of the physician must prevail as to the advisability of continuing or discontinuing the nursing. My rule has been not to wean during the summer months.

The main points have already been mentioned in this chapter under "Wet-nurse."

Weaning should not be attempted suddenly. Thus, it is better to commence weaning gradually, by withdrawing the breast in the morning and substituting a bottle for that meal. Following this meal we can again nurse the child at the breast for two feedings, and substitute a bottle for its third meal instead of the breast. In this manner we can feed the child with a bottle in the morning, to be followed in three or four hours by the breast, then at the next feeding again nurse the child, and this to be followed in three or four hours by the bottle:—

8.00 A.M.	Bottle.
11.30 A.M.	Nursing.
3.00 P.M.	Nursing.
6.30 P.M.	Bottle.
10.00 P.M.	Breast.

In this manner we can see just how the food is assimilated, and also study the individual peculiarities of

the baby. Some children are very hard to wean, and it will require great tact and patience to successfully cope with this condition. I recently saw a child in consultation which, on being removed from the breast, absolutely refused to take the bottle, and when fed with a spoon the child would spit its food out. After three or four days of this unsuccessful weaning the physician attempted more heroic methods, and insisted on isolating the child from the wet-nurse for twelve consecutive hours. This infant refused to take food even after that time, and then it was that I was summoned. We decided to give peptonized milk alternating with peptonized yolk of egg by means of rectal feeding. Thus, 1 ounce of milk and 1 ounce of starch-water were injected, followed by the peptonized yolk of egg added to the starch-water four hours later. This method of feeding can be found described in detail in the chapter on "Rectal Feeding." And also the method of rectal feeding in the chapter on "Feeding in Diphtheria Intubation Cases." Thus we aim to sustain life and avoid starvation. The rectal feeding was continued for two days more, when the child suddenly took the bottle.

In some cases forced feeding by gavage will be found useful. If the child holds its jaws firmly, the catheter can be introduced through the nasal passage, as described in the chapter on "Nasal Feeding."

I was called to see a perfectly healthy child, about 9 months old, whose mother told me that "he would not take the breast." She was greatly chagrined, but all efforts at nursing him proved futile. The infant had weaned himself. Such cases of "autoweaning" are very rare.

AFTER-WEANING DIET.

When weaning is successfully accomplished, then great care must be exercised, owing to the change in diet. It will be found that the slightest error in overfeeding or too frequent feeding will be rewarded by a severe attack of dyspepsia and the usual gastric disturbances, such as vomiting and fermentation in the stomach, causing diarrhœa and possibly colic. It will therefore be very necessary to exercise good judgment in the choice of both quality and quantity of food during the first month or two after weaning or until the stomach adapts itself to this new way of feeding. The amylolytic function now being thoroughly developed, we can safely give cereals.

TIME OF FEEDING.

Excepting in rare instances after a child is weaned it should not be fed oftener than once in four hours. The best time for feeding would be about 6 A.M., 10 A.M., 2 P.M., 6 P.M., and 10 P.M. if the child is awake. This would give eight hours rest, and healthy children can be trained to sleep that amount.

The first bottle after sleeping should consist of 8 ounces of pure cows' milk.[19] This would be the 6-A.M. feeding.

Four hours later, or at 10 A.M., the infant should receive the white of a raw egg fed with a spoon from a wine-glass immediately before its bottle, which consists of:—

Cows' milk	5 ounces.
Barley-water	2 ounces.

At 2 P.M. our next feeding shall consist of 8 ounces

[19] The best milk obtainable in this city is undoubtedly milk received direct from the dairy the same day of milking, in bottles.

of pure cows' milk. I usually permit the infant to nibble on one-half piece of the ordinary zwieback.

The evening meal at 6 P.M.:—

Cows' milk	6 ounces.
Barley-water	2 ounces.

The last feeding at 10 P.M., if the child is awake, or at midnight shall consist of 8 ounces of pure cows' milk.

When milk is brought from the dairy there is a thick layer of cream on the top of the milk, which should be thoroughly mixed with the milk by shaking the bottle so that the infant receives a thoroughly-mixed milk containing the same quantity of cream in each feeding. The milk should be mixed and the barley-water added to it. It is then poured into thoroughly-clean bottles, which are stoppered with ordinary cotton stoppers. This can be found described in detail in the chapter on "Sterilization." This food is to be steamed for twenty minutes and then allowed to cool by placing the bottles in a refrigerator, but not on the ice. When ready for use each bottle is to be warmed to a temperature of about 100° F. for the feeding. If constipation follows the use of this diet, then a good plan is to substitute 2 ounces of oatmeal-water instead of the barley-water above mentioned. When the stools are regular and the child appears to be quite pale, then great good can be accomplished by adding 2 ounces of almond-milk instead of the oatmeal- or barley- water. The preparation of almond-milk can be found described in the "Dietary," to which I beg to refer my readers. If a severe form of constipation, with cheesy curds in the stools, exists, then the milk should not be steamed, but fed in the "raw state." It is self-understood that it should be warmed to the body-heat before feeding to the infant.

Instead of giving the white of egg every day I substitute either 1 or 2 ounces of a good beef-soup or chicken-soup or beef-tea and expressed steak-juice, and feed this quantity immediately before the 10-A.M. bottle of milk. No distinct change of food will be necessary until the child is twelve or fifteen months old, when I am in the habit of giving either $^1/_2$ saucer of oatmeal-gruel with some butter or some hominy and butter in addition to a morning bottle. In the evening when the child arrives at this age a half-dozen teaspoonfuls of junket can be fed before the evening bottle of milk. At this age, when a child is over one year or about fifteen months old, instead of giving water for thirst I frequently give prune-water made by boiling good fleshy prunes in water for one-half hour and straining off the liquid. When oranges can be procured, one or more teaspoonfuls of orange-juice can be given with advantage. Apple-sauce can also be given. Thus, my plan consists in giving each one of these foods on different days. Just at this period the addition of several teaspoons of Mellin's food has been found very beneficial. Owing to gastric derangements, it will be found necessary to frequently discontinue milk entirely. At such times the use of the milk-foods—such as Nestle's food and Mellin's food—has proved very beneficial. When diluting milk with the cereals like barley-water, rice-water, sago-water, flour ball and water, it is always better to dextrinize the diluents. This dextrinization has a decided effect on the casein, inasmuch as it splits up the curd, rendering it finely flocculent as it is found in human milk, and it is especially indicated in the period of weaning after the stomach has been accustomed to breast-milk and is suddenly forced to digest cows' milk containing a more rubbery and heavier casein, or curd.

CHAPTER XIII.

Management of Woman's Nipples.

THE MANAGEMENT OF THE NIPPLES BEFORE THE BABY IS BORN.

It is very important during the last few months of pregnancy to devote considerable time and attention to the condition of the nipples. If these be found long and round, well projecting, then it is advisable to try to harden them, because the irritation from the child will cause con-

Fig. 13.—Nipple-shield for Relief of Tender Nipples.

siderable trouble unless we seek to prevent this. For this purpose wash in winter with lukewarm water, to which some alcohol has been added (2 teaspoonfuls of alcohol to a cup of lukewarm water). In summer cold water will be found more agreeable, using the same quantity of alcohol. If the nipples are very small and flat, and do not protrude properly, then suction by means of a breast-pump, applied directly over the breast, will draw them out. In some in-

stances an ordinary clay pipe, which has a smooth bowl, the latter to be laid over the nipple, and the stem to be sucked or drawn, is satisfactory. This is to be repeated every few days. A few minutes of drawing out will suffice until the nipples are sufficiently prominent. Biedert[20] gives the following prescription for hardening the nipples:

Tannic acid..............................	1 teaspoonful.
Red wine..............................	8 ounces.

If red wine is not handy, then substitute brandy in its stead. This is to be applied after thorough washing with soap and water, and removing crusts, if they are present.

TENDER NIPPLES.

If, while nursing, the nipples crack and blood oozes from them, or if, from irritation of the child's gums biting them, the nipple is sore, then it is a good plan to allow the child to nurse through a nipple-shield. (See Fig. 13.)

Nipple-shields can be used during the nursing act, and immediately thereafter the following salve can be smeared on the nipples:—

℞ Zinc oxide, 1 drachm.
Vaselin, 1 ounce.—M.

BREAST-PUMP.

The breast-pump (Figs. 14 and 15) is a valuable addition to the nursery. It should be kept scrupulously clean by immersing it in boiling water containing a pinch of table-salt. In drawing a specimen of breast-milk for a chemical examination the breast-pump is very useful. If an infant is ill and refuses the breast,—as, for example,

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[20] "Kinderernaehrung," fourth edition, 1900, page 110.

if it has rhinitis or cold in the head, nasal obstruction, preventing it from breathing, while the nipple is in

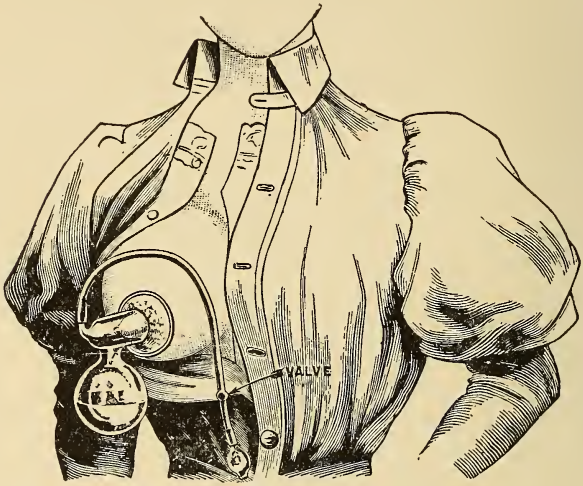

Fig. 14.—Breast-pump.

its mouth,—such infants will take the breast and immediately let go of it again. If the breast-pump is properly

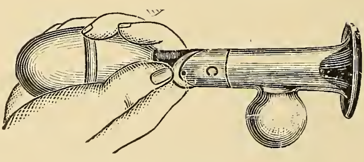

Fig. 15.—Breast-pump.

applied, and the required quantity of milk drawn off, the infant can frequently be fed with a spoon slowly.

In a serious condition,—as, for example, in a severe

case of pneumonia with loss of appetite,—the life of the child may depend on forced feeding. This will be described in the section on "Gavage." It is very important to have the cup or any other receptacle into which we draw the breast-milk properly sterilized; otherwise the breast-milk will be infected in the same manner as has been described in detail in the sections on "Cows' Milk" and "Bottle-feeding."

CHAPTER XIV.

Infant's Weight.

When a child develops normally, at either breast- or bottle- feeding, then it increases from 6 to 8 ounces each week for the first two or three months. This gain is slightly lessened toward the end of the fifth or sixth month; but if a child thrives, then its gain, be it ever so small, must be steady from week to week. We have distinct data on which to base our calculations, and any variation from the normal should be carefully investigated. If a child is breast-fed, and suddenly ceases to gain in weight, then a chemical examination of the breast-milk is imperative to know just what ingredient is wanting. If the child is bottle-fed, and the weight does not increase, then the formula is improper and frequently the addition of a larger quantity, or sometimes the changing of the quality,—as, for example, several ounces of cream instead of several ounces of milk,—will give the baby the requisite amount of food.

Table showing the Gain in a Healthy Infant Fed at the Breast.

Normal weight at birth, 7 lb.	Gain at the end of the first week, None.
Weight when 2 weeks old, 7 lb. 6 oz.	Gain at end of 2 weeks, 8 oz.
Weight when 3 weeks old, 7 lb. 14 oz.	Gain at end of 3 weeks, 8 oz.
Weight when 4 weeks old, 8 lb. 6 oz.	Gain at end of 4 weeks, 6 oz.

The vital factor is certainly the general condition of the infant, whether it is bright and playful, sleeps quietly, and the condition of its stools. When the latter are normal as to color and frequency, then we may be sure that the baby is thriving.

During the second month the infant should gain about 8 ounces per week; roughly speaking, an ounce per day is a good average.

During the third month a child should gain an ounce per day, or about 2 pounds per month.

After the third month, an infant usually gains about 3 to 4 ounces per week; so that if a child has doubled its weight at the end of the fifth month, such a child should be considered normal, if the other conditions warrant such an opinion. An infant should weigh three times its weight at birth by the end of its first year.

Taking seven pounds as the average weight for an infant at birth, it should weigh 14 pounds at the end of five months and 21 pounds at the end of its first year.

Weighing to determine the Quantity of Milk an Infant has taken Immediately After Nursing.—When scanty milk-supply is suspected in either the nursing mother or in a wet-nurse, then we can, in some instances, resort to weighing immediately after the baby has nursed. It is self-understood that the child must be weighed both immediately before nursing and then immediately after nursing. The difference in weight is the amount of milk swallowed.

While this may serve in some cases, the author has not found it very practical, and cannot recommend it, excepting in rare instances.

It is well known that an infant whose stomach is filled after nursing requires rest, and, the less it is handled, the less is the chance for expelling its food. Thus, my advice

is not to handle or fumble with a child after nursing, but rather aid Nature in resting an infant than try to provoke vomiting by unnecessary handling.

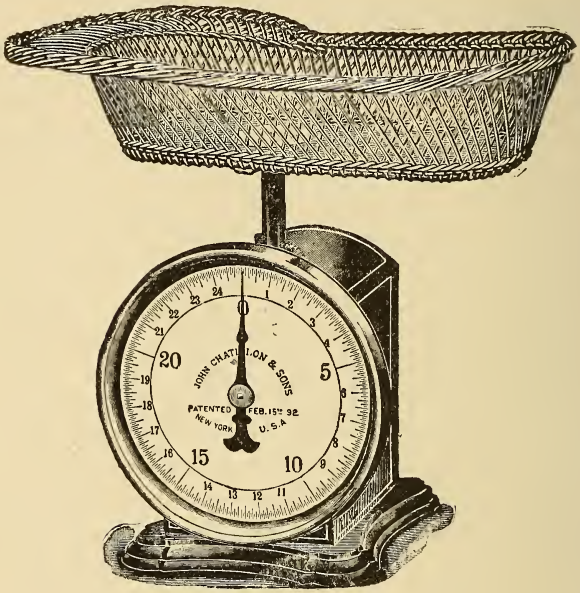

Fig. 16.

Difference in Weight Before and Immediately After Nursing.—An infant should weigh, if under 3 months old, 3 ounces more after nursing, and in older children, 5 to 6 months, it should weigh at least 6 ounces more after suckling.

Weight-chart for an Infant.

Week after Birth.	Date of Weighing.	Weight of Child with Clothes	Weight of Clothes	Body-weight	Kind of Food; Quantity and Frequency of Feeding.	Stools
On the birthday. After 1 week . . 2 weeks . 3 weeks . 4 weeks .						
After 5 weeks . 6 weeks . 7 weeks . 8 weeks .						
After 9 weeks . 10 weeks . 11 weeks . 12 weeks .						
After 13 weeks . 14 weeks . 15 weeks . 16 weeks .						
After 17 weeks . 18 weeks . 19 weeks . 20 weeks .						
After 21 weeks . 22 weeks . 23 weeks . 24 weeks .						
After 7 months. 8 months. 9 months. 10 months. 11 months. 12 months.						

Properties of Human Milk.

Appearance.	Bluish, semitransparent, no odor, sweetish.
Specific Gravity.	1.26 to 1.36.
Reaction.	Amphoteric, relation of alkalinity and acidity as 3 to 1.
On Boiling.	Does not coagulate, and forms a very thin, hardly-perceptible skin.
Coagulates.	At ordinary temperature after several hours.
Coagulates on addition of Lab-ferment.	Coagulates imperfectly in small isolated flakes, which do not precipitate as a uniform coagulum.
Fat.	Yellowish white, resembling cow-butter. Specific gravity at 15° C., 0.966. Melts at 34° C.
Varieties of Fat.	Butyrin, palmitin, stearin, olein, myristin. caproin.
Behavior of Various Acids.	Few volatile acids. More than half of the non-volatile consist of oleic acid.
Milk-plasma Casein.	Difficult to precipitate with acids and salts. The precipitate redissolves in excess of acids. During pepsin digestion there is no pseudonuclein produced.
Composition of Albuminoids.	Lactalbumin and lactoglobin; relation of casein to albumin, 0.5 to 1.2 or 1 to 2.4: of the 1.3 per cent. albumin, there are 64 parts of casein, and 37 parts of globulin and albumin.
Solids.	Less solids than in cows' milk, especially $CaO—P_2O_5$.
Quantitative Analysis, according to Soxhlet.	Water, 87.41; albuminoids, 2.29; fat, 3.78; milk-sugar, 6.21; solids, 0.31.
Bacteria.	Usually sterile, rarely staphylococcus albus and aureus.

PROPERTIES OF COWS' MILK.

Appearance.	Opaque white or whitish yellow, in thin layers bluish white, slight odor, faintly sweet.
Specific Gravity.	1.28 to 1.36.
Reaction.	Amphoteric; relation between alkalinity and acidity, 2 to 1; Soxhlet maintains that cows' milk contains three times the acidity of human milk.
On Boiling.	Does not coagulate and forms a skin containing casein and lime-salts.
Coagulates.	Coagulates very soon, owing to lactic-acid formation.
Coagulates on addition of Lab-ferment.	Coagulates to a solid mass at body-temperature, from which a yellowish fluid can be expressed.
Fat.	Yellowish-white mass. Sp. gr. at 15° C., 0.949 to 0.996.
Varieties of Fat.	Palmitin, olein, stearin, myristin, caprilin, caprin, caproin, butyrin, laurin, lecithin, cholesterin, and yellow coloring matter.
Behavior of Various Acids.	Volatile fatty acids, about 70 per cent.; not volatile, 0.3 to 0.4 per cent. of oleic; the remainder consists of palmitic and stearic chiefly.
Milk-plasma Casein.	Easy to precipitate with acids and salts; excess of acid does not dissolve; belongs to the nucleo-albumin group.
Composition of Albuminoids.	Less lactalbumin and globin; the largest portion of the albuminoids is casein. Relation of casein to albumin, 0.3 to 3.0, or 1 to 10.
Solids.	Cows' milk contains more solids than human milk.
Quantitative Analysis, according to Soxhlet.	Water, 87.17; albuminoids, 3.55; fat, 3.69; milk-sugar, 4.88; solids, 0.71.
Bacteria.	Contains all milk bacteria, frequently also pathogenic bacteria, as typhoid, diphtheria, and tubercle bacilli, etc.

CHAPTER XV.

Raw Cows' Milk.

The ideal cows' milk is clean, raw milk. By this is meant milk free from all possible contamination. Such milk should be obtained from a stable having all modern hygienic surroundings. If greater attention were bestowed on the condition of the cow, the cow's udder, the stable, the bucket, the hands of the milker, then less sterilization and pasteurization would be necessary. For let it be distinctly understood that certain chemical changes are brought about in milk, when it is steamed, be it in the process of sterilization or pasteurization. Neither pasteurization nor sterilization adds to the digestibility of milk. In fact, clinical experience has demonstrated the fact that raw milk, known in some places as certified milk, in the milk-laboratories in New York City as guaranteed milk, is more easily assimilated, as proved by the condition of the stools as well as the gastric digestion.

Nature has given us a good example of how milk should be fed to an infant. Breast-milk is certainly raw milk, and is served to the infant at a temperature of the body. Not only does boiling or steaming milk produce chemical changes in the albuminoids, but it renders the process of digestion much more difficult, and thus it is that most infants taking boiled milk suffer with constipation. This is not so, however, in the case of infants fed on raw milk.

When sterilized and pasteurized milk will be found to disagree with children, raw milk may sometimes be easily assimilated. Thus it will be found that, while boiled milk

or sterilized or pasteurized milk, given either whole or with its proper dilution to suit the various ages, will provoke constipation, by substituting raw milk instead of the heated milk the same will be more easily assimilated. The author has frequently noted decided antiscorbutic properties in fresh raw milk. In children with decided rickets, and even scurvy, the withdrawal of sterilized or other milk, and the substitution of fresh raw milk will work surprising changes.

Biedert, in his fourth edition of 1900, page 184, states that he has followed Escherich and Epstein, who recommend giving full milk to children at birth. In France Budin and H. de Rothschild, and more recently E. Schlesinger, in Germany, have given undiluted milk to both sick and well children as a substitute for breast-milk. Biedert claims to have seen good results in some instances, but cannot recommend whole milk, as a rule, for feeding children. Marfan, another advocate of pure-milk feeding, believes that milk should be diluted until the fourth or fifth month, but later he advises pure-milk feeding. Schlesinger, of Breslau, while giving pure milk, gives a longer interval between the meals. That the greatest possible success is not achieved by this method of feeding in France can be judged by the statement of Marfan while discussing the subject of athrepsia. He says: "*N'a jamais vu l'athrepsie confirmée se terminer favorablement.*" Thus is seems that even we have much better results than the French, for there are certainly a great many children who can and will digest a diluted milk, and thin milk- and cream- mixtures, as shown by their stool, the sleep, and increase in weight. These same children with enfeebled digestive functions will invariably show gastric disturbances, such as vomiting, colic, constipation or diarrhœa,

restlessness, sleeplessness, and cry continually; besides not increasing in weight. This method of feeding has been tried over and over again, and thus we will be compelled to discontinue the heavier food, consisting of pure milk, and substituting a light food, consisting of diluted milk.

Fresh Raw Milk.

Just as the medical profession, and to some extent the laity, have become thoroughly impressed with the idea that milk should be boiled before being used, to insure the destruction of the microbes which it contains, Dr. Freudenreich comes forward with a series of experiments, by which he claims to prove that fresh raw milk possesses remarkable germicidal properties. According to his experiments, the bacillus of cholera, when put into fresh cows' milk, dies in an hour, the bacillus of typhoid fever succumbs at the end of twenty-four hours, while other germs die at the end of varying periods.

Milk which has been exposed to a temperature of 131° F. loses its germicidal properties. Milk which is four or five days old is also devoid of microbe-killing power.[21]

Raw-Milk Assimilation.

Vasilieff,[22] in an inaugural thesis of 1889, in St. Petersburg, details experiments made on six healthy individuals, varying from 18 to 23 years of age, restricting them for three days to a diet of fresh milk, and then for the three days following to boiled milk. The author

[21] Bacteriological World, December, 1891; Journal of the American Medical Association, February 27, 1892.

[22] Journal de Médecine, May 4, 1890; Therapeutic Gazette, June 16, 1890.

claims that his experiments have proved that the *assimilation of the nitrogenous* principles of the *boiled milk is considerably less than of fresh milk, although the difference is less marked than in the case of the fats.* Nevertheless the fæces contain considerably more fatty acids after the *administration of boiled milk than after the use of fresh milk.* He therefore concludes that the nutritive value of boiled milk *is much inferior to that of fresh milk.* He explains these differences by the hypothesis, first advanced by Schmidt, that, by boiling, a part of the casein in cows' milk is transformed into hemialbuminose.

SCURVY.

A paper on "The Uses and Prospects of Pathology," delivered at the opening of the Section in Pathology at the recent annual meeting of the British Medical Association, by Dr. W. Howship Dickinson, senior physician and lecturer on medicine at St. George's Hospital, states that a disease which presents itself as of chemical origin, if one due almost certainly to a specific deficiency in the constituents of the food may be so regarded, is *scurvy*, of which the chemical secret has apparently been so readily exposed that we ought to be almost within grasp of the chemical antidote. The conditions which give rise to sea-scurvy are generally known. It is not probably as widely recognized that *scorbutic* affections are so common on shore, among infants brought up by hand, that this form of land-scurvy is scarcely less important. It is to be attributed to the exclusion of fresh milk by various artificial preparations of it. Not that these preparations are, in themselves, injurious, but they are insufficient.

Milk in its fresh state, and of good quality, whether from biped or quadruped, is antiscorbutic; preparations

or sophistications of it are not so, or not so to a sufficient extent. *Scorbutic* hæmaturia and scurvy-rickets are but too frequent consequences of this substitution. We know the broad result, which is enough for practice, but we do not know the isolated want. What does fresh milk contain which is so essential and so difficult to preserve? We no more know this than what there is in lemon-juice to be antiscorbutic, while neither citric acid nor potash are so. The problem is attractive, like a puzzle; some day it will be solved, and then we shall wonder why it was not solved before.

Raw Meat: its Beneficial Effect Experimentally Proved.

Richet and Héricourt announced, at the meeting of the Paris Société de Biologie, June 2d, that they inoculated a number of dogs with tuberculosis more than six months ago. One-third were fed with ordinary food, and all died in three or four weeks; another set with cooked meat, with about the same results, while the third group was fed exclusively with the raw meat, and all have survived to date and are in good health.

Raw Muscle-juice Possesses Antitoxic Properties.

A. Sicard[23] says the effect of "zomotherapy"—as Richet calls his experiments with 328 dogs inoculated with tuberculosis and then fed on raw meat—indicates that the raw muscle-juice has a specific antitoxic power in regard to the tubercle bacillus. The dogs survived, on an average, 300 days, and some for two and a half years, while the control animals all readily succumbed. Sicard dis-

[23] Presse Médicale (Paris), June 13th.

cusses the various theories advanced to explain these facts, and suggests that it would be interesting to deter-

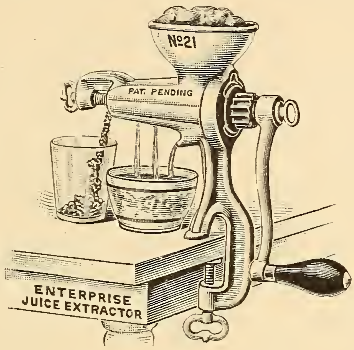

Fig. 17.

mine whether other food-elements (codliver-oil, for instance), administered to dogs and guinea-pigs in sufficient

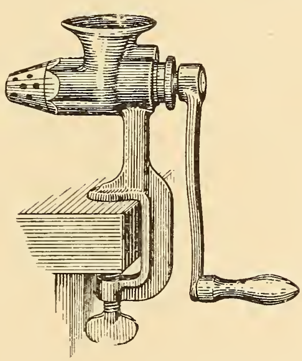

Fig. 18.

amounts, would have an inhibiting action on the evolution of experimental bacillosis; also whether forced ingestion

of raw or dried meat would transform the cellular or humoral medium in animals and render them refractory to infection.

Infant-feeding.[24]

It is impossible to go over the broad domain of artificial feeding in the time usually alloted to a discussion and do justice to all the interesting papers presented. Let me, therefore, give you in brief what would be my personal views based on clinical experience.

My first proposition in hand-feeding is: Secure the best possible cows' milk from a reliable dairy. The hygienic condition of the cows' stable to be in accord with modern sanitary laws; so that the principle of sterilization is applied to everything from the stable to the cow, to the milker's hands, and to all utensils used in milking and transportation, exactly as given by Professor Baginsky in his paper, which I had the honor to read at the last meeting of the Section on Diseases of Children at Atlantic City, June, 1900. Summing up, then, asepsis—which is really nothing but absolute cleanliness—should be rigidly enforced.

Second Proposition.—Imitate Nature in feeding, using raw milk. In this way we copy from Nature just what she has ordained for woman to feed, for it must be admitted that breast-milk (woman's) is raw milk. It is neither boiled, sterilized, nor pasteurized. When the precautions mentioned in my first proposition are carried out, there is no risk of infection.

Do we ever stop to think how many millions of mi-

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[24] Discussion on infant-feeding, Academy of Medicine, October 18, 1900, by Louis Fischer, M.D. Archives of Pediatrics, January, 1901.

crobes lie dormant in the gastro-intestinal canal ready to reinfect the sterilized milk? My plan is to give pure milk (properly diluted or pure) if the age warrants, and merely warm it immediately before feeding it to the infant—temperature of 100° F.

We know that a great many children fed on sterilized milk develop scurvy. The same holds of children fed on boiled milk. The reason is, Rundlett so ably says: "Changes take place not in the albumin, fat, nor sugar, but in the albuminate of iron, phosphorus, and possibly in the fluorin vital changes take place. These albuminoids are certainly in the milk, derived, as it is, from tissues that contain them, and are present in a vitalized form, as proteids."

On boiling, the change taking place is simply due to the coagulation of the globulin, or proteid molecule, which splits away from the inorganic molecule and thus renders it, as to the iron and fluorin, unabsorbable, and, as to the phosphatic molecule, unassimilable. This is the change that is so vital, and this only takes place when milk is boiled.

It is evident that children require phosphatic and ferric proteids in a living form, which are only contained in raw milk.

Cheadle says that phosphate of lime is necessary to every tissue; no cell-growth can go on without earthy phosphates; even the lowest form of life—such as fungi and bacteria—cannot grow if deprived of them. These salts of lime and magnesia are especially called for in the development of the bony structures.

Avoidance of Scurvy.—Since clinical experience has demonstrated that the prolonged use of sterilized and boiled milk will produce scurvy, and that improvement is

immediately noted when raw milk is given or raw muscle-juice (beef-juice) or raw white of egg, added to fresh fruit-juices, does it not seem more plausible to commence feeding at once with raw milk rather than after scurvy or rickets is developed?

There is a certain deadness, or, to put it differently, absence of freshness, that is lacking in milk that has been boiled or sterilized, just as it is the absence of fresh meats and green vegetables which is known to cause scurvy in the adult.

GENERAL RULES FOR FEEDING INFANTS.

Each child is a law unto itself, and its individual wants must be studied. One child will gain on the same mixture on which another will lose weight. The proof of the proper assimilation of food in any and every child will be the following:—

The infant must appear satisfied after taking its bottle. There should be no vomiting nor severe colicky pains.

The bowels must move (unaided) at least once or twice in twenty-four hours. They should be yellowish white and medium soft.

The infant should sleep from four to eight hours at one time during the night.

The weight must be taken regularly once a week. If an infant thrives it should gain at least from 6 to 8 ounces every week. When child's weight shows no increase, then study the reason, and by all means change the food; give more substantial food.

LABORATORY-MILK.

The sentiments expressed at the last meeting at the Academy of Medicine by A. Jacobi coincide with my

views. My experience has been that children fed on laboratory-milk have been backward in their development after its use for a long time. When first used children suffered with severe constipation; later, a distinct atony of the stomach and bowels was seen, poor appetites requiring nux vomica, delayed dentition, and finally rickets developed. Such children always looked pale, were anæmic, and their flesh was flabby. As these cases were among wealthy people with the best possible hygienic surroundings and careful nursing, the cause could only be looked for in the method of feeding. I have not had an opportunity to study this method of feeding in a tenement-house infant with unsanitary surroundings. The percentage method of feeding has always appeared to me plausible in theory, but it cannot be applied in practice. Mothers' milk changes almost at each nursing, and we know by chemical analyses that this is true several times a day. It would, therefore, be necessary, if we intended to imitate Nature, to change the formula of an infant's food several times a day.

It is a fact well known to chemists that once an emulsion of milk is broken up by centrifuging or other mechanical process, as in separating the top-milk from the skim-milk, we cannot have again as homogeneous an emulsion as prior to this breaking up of the same. And, moreover, that we add to the trouble when we, in addition, seek to improve the quality of the milk by subjecting it to the process of sterilization.

SUBSTITUTE FOR MILK IN DISEASES OF STOMACH AND INTESTINES.

When milk disagrees and the infant's stomach will not tolerate the same, and vomiting is provoked, or when gastro-intestinal trouble arises, then milk must be

stopped. At such times I have seen very good results follow the use of almond-milk (see "Dietary").

Dextrinization is successful in children having subnormal gastric digestion. The author does not advise the dextrinization of food for healthy children, but only in feeble, ill-nourished, and weakened conditions.

CHAPTER XVI.

Cows' Milk.

Hammersten[25] gives König's analysis of milk in a thousand parts as follows:—

Water		874.2
Solids		125.8
Fat	36.5	
Sugar	48.1	
Salt	7.1	
Proteid (casein, 28.8; albumin, 5.3)	34.1	

Prof. A. Baginsky[26] gives the following analysis of cows' milk, made at the Kaiser and Kaiserin Friedrich Hospital, Berlin:—

Water	87.60
Solids	12.38

In one hundred parts.

The solids consist of:—

Casein and albumin	3.65
Butter	3.11
Milk-sugar	4.54
Inorganic salts	1.08

Besides large amounts of potassium and potassium salts and small quantities of iron.

COMPOSITION, VARIATION, AND PRODUCTION.

Milk of all animals, roughly speaking, is composed of the same ingredients, but an analysis of milk is apt to be

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[25] "Physiological Chemistry."

[26] "Diseases of Children," 1899, page 32.

very misleading, as it does not show the physical condition of the milk, which is the important thing to know from the physician's stand-point.

The general ingredients of milk are fat, sugar, albu-

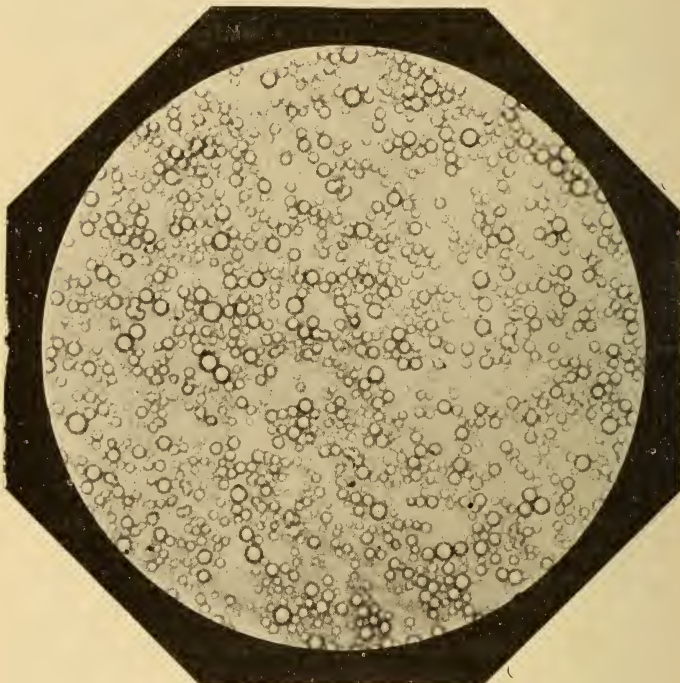

Fig. 19.—Cows' Milk, showing Fat-globules. Magnified 330 Diameters.

min, casein, mucin, salts, and water. These ingredients vary greatly in quantity from day to day and from milking to milking. An average analysis of woman's milk does not show what an infant is getting, by any means,

for the composition of the milk depends on the food and health of the mother and the frequency of nursing.

It seems to be pretty well settled that the fat in woman's milk usually varies between 3 and 5 per cent., the sugar between 4 and 8 per cent., proteids (albumin and casein) between 1 and 2 per cent., and the ash between 0.2 and 0.4 per cent., the water being about 88 per cent. Wide extremes are met with; so it is useless to think of woman's milk as of a certain composition.

Cows' milk, which is the only milk worth considering in connection with artificial infant-feeding, shows great variation in composition, just as does woman's milk. There is no such thing as average cows' milk. It may be that the mixed milk of a particular herd of cows will run uniform in composition for a long time, but this is because the variations in the milk of individual cows offset each other. A difference of 25 per cent. in the amount of fat in night and morning milk has been noticed in the milk of some cows. This is why "one cow's milk" should not be used. Mixed milk of different herds of cows will vary between 3 and 5 per cent. fat, 4 and 5 per cent. sugar, 3 and 4 $^1/_2$ per cent. casein and albumin, while the ash runs about 0.7 per cent. and the water about 88 per cent., all depending on the breed of cows and their food. Some breeds give large quantities of milk poor in solids, while others give smaller quantities of milk rich in solids.

As a general rule, the shorter the interval between milkings, the richer the milk is in solids. Dry food increases, and succulent decreases the quantity of solids in the milk. Slight febrile conditions increase the quantity of fat and albumin; depression reduces fat and albumin. Casein, sugar, and ash are the least variable ingredients.

The composition of the fat of milk and the size of

the fat-globules vary with the period of lactation, the breed of cows, and the kind of food used. Linseedmeal is said to make a soft, oily fat, while cottonseedmeal and some other foods make a hard fat. Small, hard fat-globules are noticeable when the animal becomes pregnant.

The practical problem before the physician in bottle-feeding is to prepare a food that approximates mothers' milk in composition and physical properties. To get good results good cows' milk must be used, and the physician should know that this can be had anywhere if strict cleanliness is observed by the milkman.

Aside from the difference in composition between cows' milk and woman's milk, cows' milk often contains lactic acid and other products of bacterial growth, which may cause digestive disturbance. The lactic acid is the result of the growth of the lactic bacteria that are always found in milk and which get in the milk from the dirt in the stable.

Good milk can be had by keeping the cows clean and wiping them off with a damp cloth just before milking. The first three or four jets from each teat should be thrown away, as they are always infected, and then the milking should be continued into a clean pail. The milk should then be immediately *cooled* to below 45° F., at which temperature there is little or no growth of bacteria. Unless this is done the bacteria that always get into the milk no matter how much care is exercised, will grow rapidly, and, after they have had a start, all the care possible will not repair the damage. Milk produced as described has been known to keep in good condition in summer in a refrigerator for three weeks and it is not at all unusual to buy bottled milk in New York that is forty-eight hours old that will not redden litmus-paper.

Cows' Food.—The natural food, fresh grass, is the best; next to this hay is the best. The greater the proportion of nitrogen in the food, the greater is the yield of milk, the proportion of fat being especially high. Feeding cows with brewers' grain depreciates the quality by lowering the total solids of the milk. Such feeding is illegal in a great many States, particularly Wisconsin. Beets, carrots, and swedes increase the proportion of milk-sugar.

Average Percentage of Fat.—The average percentage of fat found is 4 per cent. This does not vary, and the uniformity of milk, particularly in New York City, is certainly due to the extreme care and vigilance of the Board of Health of our city. It is not surprising that milk is so frequently adulterated when it is possible to add about 20 per cent. of water or 30 per cent. of skimmed milk to milk of average quality without the resulting mixture falling below the present requirements.

Tuberculin Reaction in Cows.

Conclusions as to the tuberculin test, in the *Bulletin of the Massachusetts Agricultural College*:—

1. Tuberculin furnishes a very delicate and reliable test, and is the only means by which tuberculosis can be stamped out.

2. A certain number of sound cows will show the tuberculin reaction.

3. A certain number of tuberculous cows will not show the tuberculin reaction.

The Cattle Commissioners of Massachusetts had, at Brighton, on February 15, 1895, 40 cattle which they had subjected to the tuberculin test and condemned as tuberculous. The figures of the tuberculin test were carefully reviewed at the office of the commission in Dorchester,

and it was decided that 13 of the lot should be killed on that day.

There were present Commissioner Herrick and Dr. Lyman, secretary of the commission; Dr. Burr, inspector for the City of Boston; and Dr. Way, acting in behalf of the owners.

At the last moment it was discovered that 3 cows had not been appraised and 10 only were killed.

Two of the 10 were undoubtedly tuberculous. Four were pronounced to be so by Commissioner Herrick and Dr. Lyman, but declared not to be so by Dr. Way. Their organs were, therefore, sent to Professor Whitney, of Harvard College, for microscopical examination. In 1 of these 4 cows an abscess was found in which was a short nail which had apparently caused it. By the most careful examination the commissioners could find no signs of tuberculosis in the 4 remaining cows, and they were accordingly dressed and sold for beef.[27]

Causes of Tuberculous Diseases in Children.

Dr. J. Walter Carr[28] has made investigations as to the starting-point of tuberculous disease in children; he made post-mortem examinations in 120 cases of children who died at the Victoria Hospital, Chelsea, Eng., of various forms of tuberculosis. He concluded that in two-thirds of the cases the disease began in the thorax and evidently was not due to tuberculous milk (that is, infection from the food) and that milk is by no means a frequent channel of infection as compared with infection by the lungs. It is often asserted that tuberculous milk

[27] "Spy," Worcester, Mass.

[28] Lancet, May 12, 1894.

causes the greater part of deaths in children; even summer diarrhœa, cerebral meningitis, peritonitis, "consumption of the bowels," etc., are laid to the door of tuberculous cows. The fallacy is that consumption (tuberculosis) in children is a generalized condition; in the adult, a localized condition. The mesenteric glands are often affected in children, but careful examination shows that the starting-place was in the thorax. The point is, not what organs are affected at death, but in what organ the disease begins. Dr. Carr says that bacilli are omnipresent, and it is impossible to keep a child from contact with them. The great points in the prevention of tuberculosis in children are the maintaining of perfect health and avoiding respiratory and gastro-intestinal catarrh, and keeping the mucous membrane healthy.

Yellowish Milk.

Before and after calving milk is yellowish, due to the presence of small, yellow bodies. Such milk is called colostrum, and in the case of cows is unfit for human consumption.

Pus-cells rather larger than the red blood-corpuscles, granulated, and with a core or irregular contour, are found, as are blood-corpuscles in the milk of sick cows. They are prevented, as Soxhlet has pointed out, from coalescing into an oily film by the condition of the albumin, which isolates the fat-corpuscles in its meshes.

Sour Milk.

When milk stands for some time, fermentative changes due to a micro-organism—usually *bacillus acidi lactici*—take place. This decomposes the milk-sugar, resulting in the production of lactic acid, which eventually

causes the milk to become sour. The change is very largely dependent upon the time the milk has been allowed to stand, and more particularly upon the temperature of the place.

When the fermentative change has resulted in the production of about 0.4 per cent. of lactic acid, the milk can be distinctly recognized, by the taste, to be sour. When the acidity reaches 0.6 per cent. the milk curdles, and it spontaneously separates into a solid, known as curd, which consists of the fatty and proteid constituents of the milk, and a clear liquid known as whey, which consists essentially of a solution of milk-sugar and mineral salts. This same change is brought about artificially when we add rennet.

Frozen Milk.

Partial freezing of milk produces a concentration of the solids in the part remaining liquid, while the part frozen is deficient in them. In winter, when milk has undergone a partial freezing, great care should be taken to allow it to thaw and then to thoroughly mix the same before allowing it to be sold.

Koumiss.

This is a preparation of mares' or asses' milk in a partly-fermented condition largely used in Russia. It is prepared as follows: The milk is allowed to cool, and is then deprived of a part of its cream; a little yeast is then added. This sets up a slow fermentation, the milk-sugar being converted into alcohol and lactic acid. During the fermentation the milk is subjected to frequent agitation, the object of which is to maintain the casein in suspension, which has a tendency to separate during the fer-

mentation. Koumiss (called Kumyss) is prepared in this country from cows' milk. The chief manufacturer is Dr. E. P. Brush, of Mt. Vernon, N. Y. Another preparation which I have used is known as zoolak and is made by Dr. Dadirrian.

Detection and Addition of Preservatives to Milk.

Those most frequently employed are: Borax and boric acid, formaldehyde, salicylic acid, and potassium chromate.

Formaldehyde[29] is the most effective, and, when the same becomes better known, it will supersede all other preservatives. The above chemicals are sold to farmers and dairymen as "milk-preservatives." The table on the following page will show the efficiency of the various milk-preservers, and is taken from T. H. Pearmain and C. G. Moor, on "Milk and Milk-products."

Formaldehyde is usually added to milk in the form of a 40-per-cent. solution, commonly called formalin; 2 or 3 drops added to a pint of milk will keep it fresh for three or four days, and the addition of 0.05 per cent. will preserve milk for months. In the trade a much more dilute solution is generally employed, namely: 1 part of formaldehyde to 80 parts of water. Rideal states that a quarter of a pint of such a solution will keep seventeen or eighteen gallons of milk fresh for at least three days, and will not

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[29] The New York Medical Record, as recently as July 21, 1900, contains the following:—

"Many milk-dealers in New Jersey have been arrested on the complaint of the State dairy commissioner for adulterating milk, the special adulterant being formaldehyde, added as a preservative."

Preservative Used.	Grains of Preservative Used per Gallon of Milk.	After Standing 2 Days.	After Standing 4 Days.	After Standing 6 Days.	After Standing 7 Days.	After 8 Days. Lactic Acid, Per Cent.	After 11 Days. Lactic Acid, Per Cent.
(Pure milk)	. . . .	Distinctly turned	Slightly sour	Sour	Sour and curdled	0.68	0.71
Formic aldehyde (40 per cent.)	8.75 0.0125 per cent.	Sweet	Sweet	Sweet	Sweet	Sweet 0.12	Sour and curdled 0.43
Formic aldehyde (40 per cent.)	17.5 0.025 per cent.	Sweet	Sweet	Sweet	Sweet	Sweet 0.10	Sweet 0.14
Formic aldehyde (40 per cent.)	35 0.05 per cent.	Sweet	Sweet	Sweet	Sweet	Sweet 0 07	Sweet 0.10
Boric acid	35 0.05 per cent.	Sweet	Sweet	Turned	Sour and curdled	0.42	0 52
Boric acid and borax (calculated to boric acid)	35 17.5 of each	Sweet	Sweet	Sweet	Sweet	Sweet 0.10	Sour 0.32
Salicylic acid	17.5 0.025 per cent.	Sweet	Sweet	Sweet	Turned	Sour 0.26	0.42
Salicylic acid	35 0.05 per cent.	Sweet	Sweet	Sweet	Sweet	Sweet 0.10	Sour 0.33
Benzoic acid	17.5 0.025 per cent.	Sweet	Sweet	Slightly turned	Sour	Sour 0.45	0.52

impart any smell or taste to the same. On tasting milk containing formaldehyde a peculiar sensation is noticed at the back of the throat, and when strong hydrochloric acid is added to it (Werner Schmidt process) the casein turns yellow and is less soluble than that of pure milk. Hehner's test is the most reliable. When milk, formalin, and sulphuric acid are mixed together a blue coloration is formed. According to Richmond and Bosely, it is best to dilute the milk with equal quantities of water and add sulphuric acid, about 90- to 94-per-cent. strength. When formalin is absent, the milk gives a *slight-greenish* tinge at the junction of the two liquids, while a *violet* ring is formed when formaldehyde is present. This color remains permanent for several days. In the absence of formalin, a brownish-red color is developed after some hours, not at the junction of the two liquids, but lower down in the acid. This cannot be mistaken by anyone who has had any experience with the test for the formaldehyde reaction. It is stated that 1 *part of formalin can be easily detected by means of this test* in 200,000 parts of milk, but the blue coloration is not obtained with milk containing over 0.5 per cent.

Another very sensitive test for the *detection of formalin in cows' milk* is the following: If to the distillate from a sample of milk 1 drop of a dilute aqueous solution of phenol is added and the mixture poured upon strong sulphuric acid contained in a test-tube, a bright-crimson color appears in the zone of contact. This color is still readily seen with 1 part of formaldehyde in 200,000 of water. If there is more than 1 part in 100,000 there is seen above the red ring a white, milky zone, while in stronger solutions a copious white or slightly-pink, curdy precipitate is obtained. This reaction has an advantage

over the one previously referred to, as it is obtained with formaldehyde solutions of all strengths, while the blue color of milk is not obtained with milk containing much formaldehyde.

Salicylic acid is not very much in vogue as a milk-preservative. It can easily be detected by Pellet's method: 200 cubic centimetres of the milk are diluted with an equal measure of water, heated to 60° C. and treated with 1 cubic centimetre of acetic acid and an excess of mercuric nitrate free from mercurous salt. The salicylic acid is extracted from the filtered solution by agitation in ether and recognized by evaporating a little of the ethereal solution to dryness and testing the residue with ferric chloride, which gives a violet color with salicylic acid.

Pearmain and Moor, in describing the bacteriology of milk, say that it usually contains a large number of bacteria derived from the external surroundings of the cow. Where these are unclean, the number may *reach three or more millions per cubic centimetre.* These can, "for experimental purposes," be completely separated by filtration through Pasteur tubes, the tubes being cleaned at short intervals. A thin, watery serum constitutes the filtrate, the whole of the fat being arrested with the organisms, so that milk cannot therefore be freed from organisms for practical purposes by any known system of filtration. Milk can be curdled by ferments even in the absence of an acid reaction. The most notable ferment is rennet, obtained from the stomach of a calf. Hueppe first pointed out that such ferments are conveyed by many different bacteria which precipitate the casein in the presence of a weakly-acid, amphoteric, or even neutral solution. The numerous tyrothrix bacilli isolated by Duclaux, the bacillus pyocyaneus, yellow sarcina, and particularly the organ-

isms described by Flügge,[30] characterized by their capacity to peptonize milk, belong to this class. Cohn[31] produced the precipitation even by means of bacteria, of which the vegetative capacity had been completely abolished with chloroform, thus showing that the fermentative action was due to a substance independent of the metabolic products of the organism. These substances have been isolated by Cohn and others. They are destroyed in most cases at from 65° to 75° C. Some ferments, however, as, for example, that described by Gorini in association with the bacillus prodigiosus, resist as much as an hour's exposure to 70° or 80° C., and require at least half an hour's exposure to 100° C. (or 212° F.) for their destruction.

It is practically inevitable that milk, as delivered from the cow, should contain a number, and usually a very large number, of bacteria. The extent of their presence is, however, affected by many circumstances, of which some are also indications of unwholesomeness or danger. Many of the organisms which are capable of causing disease do so by producing toxic decomposition-products from the milk. Their vegetative capacity increases greatly with rise of temperature, and it is therefore an essential condition of sanitary milk-production and especially of the designation of a milk as suitable for children that it should be kept at a low temperature during the whole of the interval between being drawn and being consumed.

Yellow milk is stated to be colored by the bacillus synxanthus of Schröter, the color being removed by acids and restored by alkalies.

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[30] Zeitschrift für Hygiene, xvii, page 272.

[31] Centralblatt für Bacteriologie, ix, page 653.

Salty milk is stated to occur only in connection with inflammation of the udder. It is to be detected not only by its taste and its high percentage of ash, but by its low percentage of milk-sugar. Its specific gravity is 1.027 to 1.029. According to Klenze, 2.4 per cent. of small deposits of calcium carbonate in the milk-glands may give rise to sandy milk. Curious results have been noted by Scheurlen,[32] in experimenting with bacteria in milk. He found that milk can be freed from bacteria by the operation of a centrifugal machine. He also noted that, of the large majority of bacteria contained in milk, three-fourths went into the cream on being centrifugalized, and the rest stayed in the separated milk, and the same result was obtained by merely leaving the milk stand. These results held good not only for the ordinary milk bacteria, but also for anthrax, typhoid, and cholera. The tubercle bacillus only remained to a small extent in either the milk or the cream, and the large majority was ejected under the centrifugal influence. The biological commission on milk-supply held under the auspices of the *British Medical Journal* for 1895, reported the following: 1. That all milking be carried on in the open air, the animal and operators standing on a material which is capable of being thoroughly washed, such as a floor of concrete or cement. Such a floor could be easily laid down in any convenient place which can be found. The site chosen should be removed from inhabited parts as far as possible, and should be provided with a plentiful water-supply. Only in this way does it seem possible to avoid the initial contamination with the colon bacillus. 2. That greater care should be expended on the personal cleanliness of the

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[32] Arbeiten a. d. k. Ges. Amt., vii, 1891.

cows; the only too familiar picture of the animal's hind-quarters, flanks, and side being thickly plastered with mud and fæces is one that should occur no longer. It would not be difficult to carry out this change. Indeed, in the better managed of our large dairy companies' farms such a condition no longer prevails, but in the smaller farms it is but too frequently met with. 3. That the hands of the milker be thoroughly washed before the operation of milking is commenced, and that after once being washed they be not again employed in handling the cow, otherwise than in the necessary operation of milking. Any such handling should be succeeded by another washing in fresh water before again commencing to milk. 4. That all milk-venders' shops should be kept far cleaner than is often the case at present; that all milk-retailing shops should be compelled to provide proper storage accommodation, and that the counters, etc., should be tiled.

The Breed of a Cow.

Some breeds yield quantity, others quality. Alderneys and Jersey cows yield the most, by far. Short horns give the most casein and sugar; the average capacity of a cow's udder is about 5 pints, and the average annual yield of milk is about 600 gallons.

Time and Stage of Milking.

Cows are usually milked twice a day, the morning milk usually being larger in quantity and poorer in quality. The milk which is first drawn is known as the fore-milk, and contains very much less fat than that last drawn, known as the strippings. This is due to a partial creaming taking place in the udders. Dishonest dealers have often taken advantage of this fact in adulteration cases to

have the cows partially milked in the presence of ignorant witnesses, the resulting milk consisting largely of the foremilk.

Age of Cow.

Young cows give less milk, while cows from four to seven years old give the richest milk, and less milk is given with the first calf. They give the largest yield, according to Fleishmann, after the fifth until the seventh calf; after the fourteenth calf they yield, as a rule, no more milk. The poorest milk is yielded during the spring and early summer; the richest during the autumn and early winter. If cows are worried or driven about, the quality and quantity of the milk is reduced. If they are kept warm and well fed, both quantity and quality is naturally increased.

Effect of Alkalies on Milk.

By running milk through a centrifugal machine a product known as "separator slime" is produced, which is analogous to mucin. A decided difference in viscosity is noticed between milk before and after running it through a centrifugal machine. This "separator slime" swells up and forms a viscid jelly with lime-water or alkalies. Milk to which alkali is added is decidedly more viscous than milk that is slightly acid, and is so undoubtedly because of the action of the alkali on the mucin of the milk.

Curdling of Milk and Diluents.

Milk of all animals may be separated into two classes. Those that form a soft curd with rennet and those that form a hard curd with rennet. Woman's milk is in the first class and cows' milk in the second.

The conditions favorable for the formation of hard

curds of cows' milk are body-heat and the presence of rennet and lactic or other acid.

The rennet forms a clot of the milk, the heat causes the lactic bacteria to grow in the curd, and the acid causes the curd to shrink and become leathery. Adding alkalies to the milk neutralizes the acid, but the bacteria will keep making more lactic acid as long as any sugar is present.

Diluting milk with water does not prevent tough curds forming, but diluting with gruels does prevent the contraction of the curds. This has been proved beyond dispute, both experimentally and clinically.

Albuminoids in Cows' Milk.

That there are differences in the amounts of the albuminoids occurring in human milk is proved by the fact that, while Professor Leeds found a variation of 0.85 to 4.86, Professor Meiggs asserts that there was but 1 per cent.

König, an earlier analyst, makes the variation from 0.85 to 4.86. Some of these results give as high a percentage of albuminoids in woman's milk as we find in cows' milk, and I have no doubt in my own mind that the time and habit of extracting the milk has a deal to do with the amount of occurring albuminoids. In other words, when milk is extracted every two hours or less, it cannot contain as much of the cell-material as milk from the same source extracted at intervals of twelve hours. This latter is riper and it is the non-uniformity of the tissue which causes all the difference in the different occurring albuminoids. We know that during the incubation of eggs casein is developed from egg-albumin. This illustrates the ripening of albumin. Furthermore, take an egg just laid by the hen, and boil it, and you will find immature albumin in it; that is, after boiling, instead of

being thick and firm, like an older egg, much of it is milky. If boiled a few hours later, all the albumin will coagulate perfectly, because it has had time to ripen. There is no doubt that the albuminoids in milk from healthy animals are all cell-transformations, not an exudate, as are undoubtedly the fats and salts, because these latter we can influence by the food very plainly, but in health the albuminoids are constant without regard to food, while during menstruation, pregnancy, and other conditions, notably febrile disturbances, we find the fats and salts not materially affected, but the albuminoids are decreased, increased, or totally changed, as we find in colostrum. *The casein, besides being riper in cows' milk,* by reason of its stronger growth, is intended by Nature to coagulate into a hard mass, because it is the product of a cud-chewer for the nourishment of a cud-chewer, and the reason why it does not always coagulate in the infant's stomach as it does in that of the calf is that the latter animal's stomach secretes a principle called *chymosin;* this is the principle that curdles cows' milk, and it operates either in an acid or an alkaline medium. *Pepsin will not coagulate milk,* and hence the *hard coagulum of cows' milk* that sometimes forms in the infant's stomach is due to *acidity of that organ,* and this acidity is not always the fault of the stomach, *but of the milk itself.* The variations in the chemistry of the albuminoids found in cows' milk would not be surprising to anyone if he would examine into the condition of some of its mammary sources, for often it will be found, on *dissecting a cow's udder,* which I always do when making an autopsy on a cow, that there are *old cicatrices,* one or more quarters of the udder intensely inflamed, sometimes a mammiferous duct clogged with a calculus or a clot of fibrin, and, besides these pathological conditions,

the mammary gland is subject to benign and malign infiltrations, bacillary tubercular deposits, and eruptive diseases of the skin involving the gland and ducts; therefore, that fibrin, serum, and albumin, in various forms, are found in the cows' milk is not surprising, and it can safely be assumed that any variation in the albuminoids from the normal casein can be ascribed to sickness on the part of the animal.

We next come to the salts contained in milk, and it is remarkable how few analyses have been made to determine the salts or minerals that are contained in this fluid. Heidlen's analysis, copied everywhere, seems to be the only exhaustive one of the salines in cows' milk made during the present century. It seems to me in this case, too, that it is time for the chemist to teach us something more. There probably never was a time, in our era, at least, when milk was attracting so much attention as now, and still all our chemists are content with the total solids, fats, albuminoids and sugar—just what the butter-makers and cheese-makers want to know. From this much-quoted analysis of cows'-milk salts we learn that milk contains in various proportions the phosphates of lime, magnesia, and iron; the chlorides of potassium, sodium, and iron; and free soda. Robin gets from human milk, in addition to the foregoing, carbonate of lime and soda, phosphate of soda, sulphate of soda, and potash. We have no means of knowing how constant is the occurrence of any of these salts in milk or under what conditions they are modified; we do know, however, from the experiments of Fehling, that many of the drugs administered to the *milking female are excreted in the milk.* Therefore, we can safely assume that the saline constituents occurring in milk are influenced both by the health and food of the animal. That the *phos-*

phates are craved for by the milking cow is evidenced by the habit of chewing old bones and the like, and that there is a lack of this element of food *is not to be wondered at* when we see *herds of milking cows pastured* on old, worn-out lands; the practical farmer knows that exhausted pasture-lands need, more than anything else for their rejuvenescence, the phosphates, and we know that in our nutrition we need them also. The land on which a cow is pastured will indicate pretty fairly what we may expect to find in her milk as salts. We have all noticed the excessive growth of sorrel on exhausted land, and can it then be a subject of wonder that some kind of a vegetable acid should be found in the milk of animals that are obliged to include this variety of food in their summer-rations and sour ensilage or spoiled brewery grains in their winter-feed? Theodore Hankel's discovery of citric acid in cows' milk to the amount of 0.9 and 1.1 grammes per litre is just what might be expected.

Sugar, I think, in milk has always been overestimated as to its nutritive value, because we know that *carnivorous* animals do not secrete sugar to any appreciable extent, according to chemists. When we see a small slut nursing seven or eight puppies and keeping them all fat, and in a thriving condition, we can easily imagine that sugar is not a necessary element of food, for the canines excrete no sugar in their milk. We see that the gross result of condensed-milk feeding with an excess of sugar is harmful. Brush maintains that pure cane-sugar is the ideal addition to cows' milk.

Prof. L. B. Arnold, an authority on dairy matters, says that, when milk will not properly nourish an infant, then it is not the cows' milk that is at fault, but it is either a pathological condition of the cow or improper

food or care, or the conditions through which the milk has passed on its way from the cow to the infant.

The average temperature of a cow is 102 $^1/_2$° F. (Brush). This is certainly a peculiarity of the cow. Another peculiarity is the constant employment of her generative functions: she is always milking or pregnant, and both the uterus and the mammary glands are employed almost constantly at the same time. Her nervous system is more subject to severe shocks, and she is a delicate creature. If we consider the average income from a cow, it is about $20.00 a year to the producer. This is about 7 cents a day, from which the dairyman has to buy food and pay for labor. In order to make a profit the dairyman must utilize every drop of milk, whether the animal giving it be sick or well. It is, therefore, very common to find all the cheap foods, such as brewery grains, distillery slops, and the refuse from starch-factories enter largely into the food from which our babies' supply of milk is produced. Brush maintains that, in personal inspections of small dairies near New York City, the sole article of diet was swill. One of the means employed for removing the stable odors of milk is by adding nitrate of potash, commonly known as "saltpeter." With this drug a substance resembling nitroglycerin is formed. It is strange that the toxic effects of nitroglycerin are similar to those of tyrotoxicon.

Brush believes that the ideal dairy for supplying infant-food should be composed entirely of spayed cows, and thus one constant source of nervous function of disturbance would be eliminated. He believes that these animals are much more quiet in disposition, they give a more constant and uniform supply of milk, and seem to enjoy a more even degree of health than the cow who is

occasionally bulling and becoming pregnant when giving milk. The author has certainly had very good results with Brush's milk, and, although it is somewhat expensive, he has found it well adapted for the home-modification of infants' food.

CHAPTER XVII.

CREAM.

WHEN food contains too little fat, or its equivalent (cream), we have fat-starvation, which is soon manifested by symptoms of rickets. One of the earliest symptoms of rickets is constipation, showing deficient muscular tone: a distinct atony of the bowel.

This can be remedied by the addition of fat or cream to the food. Some children are benefited by giving them codliver-oil, butter, or olive-oil. Some authors advise giving fried bacon to very young children; thus it is plain that each one desires to remedy the deficiency of fat in his own manner.

In buying cream from small milk-stores one can make a rough guess at the proportion of fat in cream by its thickness. A 50-per-cent. cream at the ordinary temperature of the room runs from a jug slowly and in a thick stream, almost like thick mucilage, whereas a 16-per-cent. cream runs almost as freely as milk. This is, however, a crude way of estimating the difference between poor and rich cream. It is a very important point to know exactly what percentage of cream we are using, for such mixtures like Biedert's, in which 1 ounce of cream is mixed with 3 ounces of water, may agree very well when we use a 16- or 20-per-cent. cream, but might be disastrous if we used a cream containing 40 per cent. of fat. Such infants would not tolerate this rich cream, but might have troublesome vomiting.

CREAM FOR HOME-MODIFICATION.

Ordinary Cream.—This is made by setting milk at night and skimming it in the morning; it is called gravity, or skimmed, cream, and contains 16 per cent. of fat.

Twelve-per-cent. Cream. — Obtained in the city by using equal parts of ordinary (20 per cent.) centrifugal cream and plain milk. In the country we must use 2 parts of ordinary skimmed, or gravity, cream (16 per cent.) with 1 part of plain milk, or by taking the top layer of milk after standing five or six hours, by means of siphoning.

Eight-per-cent. cream is obtained in the city by diluting 1 part of centrifugal (20 per cent.) cream with 3 parts of plain milk; in the country, by using 1 part of gravity cream and 2 parts of plain milk, or by using the top layer of milk after standing five or six hours and siphoning it off.

Top-milk is obtained directly from fresh milk by the so-called "gravity process." Cream contains a great deal of fat, usually three-fifths of cream is fat; this floats on the surface of the watery milk. If a quart bottle of the average city milk is put into ice-water or upon ice in the refrigerator, and removed after four or five hours, we can skim off from the top about 10 ounces of an 8-per-cent. cream; after six hours about 6 ounces of 12-per-cent. cream. This I shall speak of as top-milk. Frequently, instead of skimming the cream, the lower portion is siphoned off, leaving the cream in the glass bottle. When cream is removed by a centrifugal machine, it is known as centrifugal cream. It can be separated much quicker from milk than milk which must stand and rise naturally (slow process): so-called gravity cream.

HOW TO PROCURE CREAM.

Set aside the ordinary quart bottle of milk on the ice for several hours (from six to eight hours) to allow the cream to rise. Draw the milk after the cream has risen from the bottom of the bottle; this can be accomplished by means of a siphon.

To make the siphon get a piece of glass tubing 21 inches in length and a quarter of an inch in calibre. This can be procured in every drug-store. German glass is less liable to crack than American glass. If the glass tubing is longer than 21 inches make a small scratch in it, after measuring off 21 inches, with a three-cornered file; then catch the glass tubing between the fingers and opposing thumbs of both hands, having the thumb-nails touching on the side of the glass just opposite to the scratch. On attempting to bend the glass tube it will break smoothly across, and if there are any sharp edges they can be smoothed by rubbing them down with the file.

To bend the glass tube to the V shape, hold it in the flame of an ordinary gas-jet or alcohol-lamp for a few moments, twirling the glass rod until it softens sufficiently to allow it to be bent to the required angle. The tube should be warmed gradually at first, and then put right into the flame. It is better in bending the glass to make one arm of the siphon a few inches longer than the other.

In using the siphon hold it with the angle down, fill it with water and close the long arm with the tip of the finger, then keeping the finger applied to the long end, turn the siphon with the angle up, and introduce the short arm into the bottle of milk, letting it rest upon the bottom. On removing the finger, the milk will flow through

the tube, and continue to do so until the bottle is empty. It is, therefore, necessary to watch the layer of cream, so that the siphon can be lifted out of the bottle just before the cream reaches it, and thus remain in the milk-bottle all of the cream and a small portion of the milk, the latter depending upon the expertness of the person using the siphon.

TO PASTEURIZE THE CREAM.

Take a clear glass bottle not having the neck very wide; fit a perforated cork into the same having a chemical thermometer registering up to 212° F. The bulb of the thermometer should come within half an inch of the bottom of the bottle. The cream is put into the bottle, and the cork containing the thermometer is inserted; the bottle is then placed in a pot containing a couple of inches of warm water and allowed to heat on the stove. The thermometer should be watched until it reaches 160, taking care that it does not go above 170. When the thermometer has reached this point, set the pot back on the stove where it will cool off, and allow it to remain there for twenty minutes. At the end of this time substitute a plug of absorbent cotton for the cork containing the thermometer. Great care must be taken to keep the absorbent cotton dry. Cream thus prepared is pasteurized, and will keep sweet and fresh for twenty-four hours without being kept on ice, and all that is necessary in removing a portion from the bottle is to be sure that the cotton plug does not become moist, or, if it should, to replace it with a dry piece at once.

TO CLEAN THE GLASS SIPHON.

It is advised immediately to fill it with water after using it, and the ordinary tube-brush having eighteen

inches of wire added to it will lengthen the same and permit thorough cleansing. Nothing, however, will be found as good as thorough boiling in plain water to which a pinch of soda has been added.

Modification of Milk.

It has been shown previously that the percentages of fat in woman's and cows' milk are about the same, that the quantity of sugar is rather lower in cows' milk, and that the quantity of casein and albumin is greater in cows' milk, as is also that of the ash. Experience has shown that cows' milk must be diluted before it can safely be fed to infants. Simply diluting the milk reduces the percentages of fat and sugar too much; so the practice of adding cream and sugar has arisen, but the processes that have been advocated for obtaining the desired additional quantities of fat and sugar have been too complicated for general use.

The top 9 ounces of a quart of milk on which the cream has risen will be about three times as rich in fat as the whole milk, the top 15 or 16 ounces will be about twice as rich as the whole milk, while the other ingredients remain about the same as in whole milk.

For babies under 3 months of age the top 9 ounces of a quart of milk on which the cream has risen should be diluted from 3 to 10 times and 1 part of sugar added to 25 parts of food.

For babies 3 to 6 months old the top 16 ounces of a quart of milk on which the cream has risen should be diluted 2 or 3 times and 1 part of sugar added to 25 or 30 parts of food.

For babies 6 to 9 months old the top 20 ounces of a quart of milk on which the cream has risen should be di-

luted $^1/_2$ to 1 time and 1 part of sugar added to 50 parts of food. An even tablespoonful of granulated sugar equals $^1/_2$ ounce.

By following this method the infant commences on weak mixtures that show about the same composition and variations as mothers' milk and gradually takes food richer in casein until plain milk is reached.

The diluents used are water, gruels, or dextrinized gruels, which are simply ordinary gruels the starch of which has been converted into soluble forms, leaving the cellulose and proteids of the cereal in a finely-divided state. The effect of the different diluents will be mentioned farther on.

Milk-sugar Solutions.

1. Take 1 ounce of milk-sugar and 20 ounces of water, and dissolve. Or 1 even tablespoonful of milk-sugar and 7 $^1/_2$ tablespoonfuls of water, and dissolve.	This makes about a 5-per-cent. sugar solution.
2. Dissolve 1 tablespoonful of milk-sugar in 6 $^1/_2$ ounces of water. Or 1 ounce of sugar is to be dissolved in 16 $^1/_2$ ounces of water.	Makes a 6-per-cent. sugar solution.
3. Dissolve 1 ounce of sugar in 14 ounces of water. Or 1 even tablespoonful in 5 $^1/_2$ ounces of water.	Makes a 7-per-cent. sugar solution.
4. Dissolve 1 ounce of sugar in 12 $^1/_2$ ounces of water. Or 1 even tablespoonful in 12 $^1/_2$ ounces of water.	Makes an 8-per-cent. sugar solution.
5. Double the strength of above milk-sugar (Formula No. 1).	Makes a 10-per-cent. sugar solution.

ADDITION OF SUGAR TO MILK.

In order to render milk palatable, sugar must be added in some form; hence cane-sugar or milk-sugar has been advised. Jacobi insists on the addition of cane-sugar, and he agrees with Biedert, who uses it in his cream-mixture. That cane-sugar certainly has some virtue can be seen by the fact that it is used extensively as a preservative in the manufacture of condensed milk.

Cane-sugar. — Cane-sugar, being far sweeter than sugar of milk, it is advisable to use $^1/_2$ the quantity that would ordinarily be used for sweetening with milk-sugar. Cane-sugar is advised in the treatment of constipation; frequently we find breast-fed babies who suffer constipation, the cause of which is deficiency in sugar. In such cases giving $^1/_2$ lump or about $^1/_2$ teaspoonful of cane-sugar dissolved in a teaspoonful of sterile water (ordinary boiled water), and this given immediately before putting the baby to the breast, will make up the deficient sugar and frequently modify a distressing constipation without resorting to drugs.

Contra-indications to the Use of Sugar.—There are a great many conditions in which the addition of sugar is not only contra-indicated, but absolutely harmful. For example: If an infant suffers with colic and has sudden attacks (paroxysms) of pain which disturb the infant's sleep, such an infant will be found with its legs drawn up to its belly, and besides it will utter shrieks while crying. The stools will be usually green and sour smelling, and the abdomen will be found greatly distended with gas from fermentation, and frequently the infant will have violent eructations. Such an infant usually receives an excess of sugar. The treatment of such a case is the absolute discontinuance of sugar in the food.

HOW SHALL WE SWEETEN?

If constipation has accompanied the infant's fermentative condition and has also preceded this attack of colic, then I advise adding glycerin to the milk. It has a very sweet taste and a decided laxative effect.

Dose of Glycerin.—For some children half a teaspoonful of glycerin added to each bottle will suffice; for others, I frequently use 1 teaspoonful to each bottle, rarely more. Glycerin has a decided antifermentative effect; being an oil, it is indicated in children requiring the addition of fat. It certainly has decided nutritive properties.

SOLUTIONS USED FOR RENDERING COWS' MILK ALKALINE.

Lime-water is the alkali usually selected for neutralizing the acidity in cows' milk. It acts by partly neutralizing the acid of the gastric juice, so that the casein is coagulated gradually and in small masses, or passes, in great part, unchanged into the intestine, to be there digested by the alkaline secretions. As it contains only $^1/_2$ grain of lime to the fluidounce, the desired result cannot be attained unless at least a third part of the milk-mixture be lime-water. Instead of lime-water, 2 to 4 grains of bicarbonate of sodium may be added to each bottle, or, better still, from 5 to 15 drops of the saccharated solution of lime.

This solution is made in the following way:—

℞ Slaked lime, 1 ounce.
Refined sugar, in powder, 2 ounces.
Distilled water, 1 pint.

Mix the lime and sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water,

and, having closed this with a cork, shake it occasionally for a few hours. Finally separate the clear solution with a siphon and keep it in a stoppered bottle.

Bicarbonate-of-Soda Solution (*Baking-soda*).—Take 1 grain of soda bicarbonate to $^1/_2$ ounce of water. Or 1 drachm of soda bicarbonate to 1 quart of water. This is the proper strength used for diluting milk.

Quantity to be Used.—One tablespoonful of the last-named solution equals in strength 1 tablespoonful of ordinary lime-water.

Both lime-water and soda-bicarbonate solution should be kept in a very clean, well-stoppered bottle and in a cool place.

CHAPTER XVIII.

Water.

Of all the necessities of an infant, water stands out most prominently. It will aid materially in clearing the mouth and gums and quench the thirst. It is certainly diuretic, and water given regularly is one of our best laxatives. It is a good rule, and one that I insist upon, namely: to instruct every mother and nurse that a child, young or old, *must* receive water several times a day.

Quantity.—An infant up to the first month shall receive several teaspoonfuls of plain sterile (boiled) water, which has been allowed to cool, but by no means ice-water.

This drink of water is best given either immediately after nursing or feeding or as soon after the feeding as possible.

It is not necessary to awaken the child to give it a drink, but if it is not time for *feeding* and the infant is restless, a few spoonfuls of cool water will frequently comfort it.

When we desire to modify constipation, then water will be a most important factor, especially so when large, cheesy curds are found in the stool.

Instances will be found in which some children will refuse water; then the slightest addition of a few grains of granulated (cane-) sugar will prove advantageous. Older children, over six months old, can, if properly developed, take hold of a glass and be guided in the drinking or sipping of a wineglassful of water. I advise giving at least 3 wineglassfuls of plain sterile (boiled) water per day, especially during warm weather.

The free dilution of children's nourishment with water is demanded upon the following additional facts: Only to a certain limit will pepsin be furnished for digestive purposes. Probably a portion of this is not entirely utilized. A great quantity of water is necessary to assist in pepsin digestion. In artificial digestion albumin often remains unchanged until large quantities of acidulated water are supplied. Without doubt many disturbances of digestion are to be explained by a deficiency of water, certainly many more than are due to an excess of it, as it is so quickly absorbed.

CHAPTER XIX.

Bottle-feeding, or Hand-feeding.

Cleanliness.—The most important point to remember is that everything used in connection with "hand-feeding" must be scrupulously clean.

To sterilize milk in a filthy bottle, or to put milk contaminated with stable filth or dirt from the udder of a cow, or milk containing pathogenic bacteria, into an absolutely-clean bottle, is surely repulsive.

Therefore, my first proposition is: "clean everything that is associated with infant-feeding," from the milking of the cow, the surroundings of the cow, until the food is ready to be fed to our infants. This necessarily implies quite an amount of work, which I shall try to detail later on.

Amount to be Fed.—Ssnitkin (investigations at the Children's Hospital of St. Petersburg, quoted by Rotch) makes the following rule: "The greater the weight, the greater the gastric capacity."

Ssnitkin's table of calculation shows that one one-hundredth of the initial weight should be taken as the figure with which to begin the computation, and to this should be added one gramme for each day of life.

Illustration of Ssnitkin's Rule.

Initial Weight.	*Early Days.*	*At 15 Days.*	*At 30 Days.*
3000 Gm.	30 Gm. (About 1 oz.)	30 + 15 = 45 Gm. (About 1½ oz.)	30 + 30 = 60 Gm. (About 2 oz.)
4500 Gm.	45 Gm. (About 1½ oz.)	45 + 15 = 60 Gm. (About 2 oz.)	45 + 30 = 75 Gm. (About 2½ oz.)
6000 Gm.	60 Gm. (About 2 oz.)	60 + 15 = 75 Gm. (About 2½ oz.)	60 + 30 = 90 Gm. (About 3 oz.)

CHAPTER XX.

Feeding-table and Cream-mixtures.

Age.	Intervals of Feeding.	Number of Times in 24 Hours.	Average Amount Each Feeding.	Average in 24 Hours.
1st week	2 hours	10	1 oz.	10 oz.
1st month . . .	2 hours	8	1½ to 2 oz.	12 to 16 oz.
2d month . .	2½ hours	8	3 to 4 oz.	20 to 30 oz.
3d and 4th mos.	3 hours	7	4 to 5 oz.	30 to 35 oz.
5th and 6th mos.	3 hours	6	6 to 7 oz.	34 to 40 oz.

The above is the feeding-table of George C. Carpenter (London).

BIEDERT'S CREAM-MIXTURES.

The following formulæ are from the fourth edition of his book on "Infant-feeding," published in 1900:—

Formula.	*Cream.*	*Water.*	*Milk-sugar.*	*Milk.*	*Casein.* Per Cent.	*Fat.* Per Cent.	*Sugar.* Per Cent.
I.	4 oz.	12 oz.	4½ dr.		0.9	2.5	5
II.	4 oz.	12 oz.	4½ dr.	2 oz.	1.2	2.6	5
III.	4 oz.	12 oz.	4½ dr.	4 oz.	1.4	2.7	5
IV.	4 oz.	12 oz.	4½ dr.	8 oz.	1.7	2.9	5
V.	4 oz.	12 oz.	4½ dr.	12 oz.	2.0	3.0	5
VI.		8 oz.	3 dr.	24 oz.	2.5	2.7	5

		Cream.	*Milk.*	*Water.*	*Milk-sugar.*		*Casein.* Per Cent.	*Fat.* Per Cent.	*Sugar.* Per Cent.
1.	1st mo.	℥iv.	No.	℥xij.	℥ss.	Is equivalent to	1.0	2.4	3.8
2.	2d mo.	No.	℥ij.	No.	No.	Is equivalent to	1.4	2.6	3.8
3.	3d mo.	No.	℥iv.	No.	No.	Is equivalent to	1.8	2.7	3.8
4.	4th mo.	No.	℥viij.	No.	No.	Is equivalent to	2.3	2.9	3.8
5.	5th mo.	No.	℥xij.	No.	No.	Is equivalent to	2.6	3.0	3.7
6.	6th mo.	No.	℥xvj.	℥viij.	ʒiiss.	Is equivalent to	3.2	3.0	4.0

The latter are known as Biedert's cream-mixtures, and are quoted by A. Jacobi.[33]

According to recent milk-analyses, it is necessary to take 6 per cent., which is equivalent to 5 $^1/_2$ drachms of sugar, to 12 ounces of water. It has also been shown that cane-sugar in the same quantity as milk-sugar can be used. In using Formula 5, especially if an infant is constipated, it is advisable gradually to substitute milk for the water; thus we take away 1 ounce of water, and add 1 ounce of milk, until our formula is:—

Cream.	*Sugar-water.*	*Milk.*
4 ounces.	4 ounces.	20 ounces.

and gradually arrive at a whole-milk feeding; in other words: give pure cows' milk undiluted. Biedert claims that frequently diluted cows' milk was not well borne, especially on weak stomachs, and the change to the cream-mixture resulted in decided benefit. Moreover, he believes that the cream-mixture is assimilated far better than the diluted milk-mixtures not containing cream.

Thus he claims that those cases of constipation alternating with diarrhœa and lastly mucous enteritis are those in which the cream-mixture will render satisfaction; but he advises that a definite rule must prevail regarding the amount of fat contained in the cream, and he advises that an 8- to 10-per-cent. cream be used.

BIEDERT'S DIRECTIONS FOR MAKING HIS CREAM.

From 1 to 2 quarts of milk are put into a broad jar (glass) on the ice, for no longer than two hours. He then removes with a flat spoon from 3 $^1/_2$ to 7 ounces of the

[33] "Therapeutics of Infancy and Childhood."

thin white creamy layer over the bluish mass of milk. In removing the above quantity a small portion of the milk will be removed with it. *In cases of severe constipation Biedert insists on removing pure cream.*

The above Formula I is for the first month, Formula II is for the second month, Formula III is for a child from three to four months, Formula IV is for fourth to fifth month, Formula V is for the sixth to seventh month, and Formula VI is for the eighth to tenth month.

It is self-understood that, while feeding, the general condition of the child is the criterion, and thus we will frequently be compelled to change the formula for individual requirements, some infants requiring far more cream than the above-mentioned formulæ give them for their age and their weight, whereas the great majority will require a modification of far less cream than the above-given formulæ for their age and weight.

CHAPTER XXI.

Home-modification of Milk.

coit's decimal method (tuttle, gallaudet).

This is the simplest and easiest-worked method of home-modification yet suggested. It is based on the metric system, and all the calculations are made in decimals.

Three solutions are required: 1. A decimal (10 per cent.) cream, or superfatted milk for introducing the fat. 2. A saccharated (10 per cent.) skimmed milk for introducing proteids not carried by the cream. 3. A standard (10 per cent.) sugar solution for introducing the lactose not carried by the cream or the skimmed milk. Solutions 1 and 3 only are required when the proteid percentage is small. As the child grows older, and a higher proteid percentage is necessary, solution 2 is required also.

Decimal cream is produced by allowing a quart of ordinary fresh milk from a mixed herd to stand on ice for fifteen hours, and at the end of this time one-fifth of it is taken from the top. This averages 15 per cent. of fat, and loses about $^1/_2$ per cent. each of sugar and proteids. If to this we add $^1/_2$ its volume of water, a decimal cream is obtained, analyzing: 10 per cent. of fat, 2.33 per cent. of proteids, and 2.66 per cent. of sugar. From this the following formulæ, showing the amounts of proteids and lactose coincidently introduced with any definite fat-percentage, are easily deduced:—

Decimal cream in introducing 4 per cent. of fat also introduces 1 per cent. of proteids and 1 per cent. of lac-

tose. Decimal cream in introducing 3.5 per cent. of fat also introduces 0.8 per cent. of proteids and 0.9 per cent. of lactose. Decimal cream in introducing 3 per cent. of fat also introduces 0.7 per cent. of proteids and 0.8 per cent. of lactose. Decimal cream in introducing 2.5 per cent. of fat also introduces 0.6 per cent. of proteids and 0.7 per cent. of lactose. Decimal cream in introducing 2 per cent. of fat also introduces 0.5 per cent. of proteids and 0.5 per cent. of lactose.

Saccharated skimmed milk depends on the fact that skimmed milk analyzes 4 per cent. of proteids and 5 per cent. of sugar. Five per cent. more of lactose is added simply for convenience of calculation. This means adding 1 ounce, by weight, of lactose to 20 ounces of skimmed milk. Our solution then analyzes: proteids, 4 per cent.; and lactose, 10 per cent. If we wish to add 1 per cent. of proteids, we use one-fourth of the total food required from solution 2; if 0.5 per cent. of proteids, one-eighth, etc., always remembering that we introduce coincidently two and one-half times as much sugar. The formulæ here deduced are also plain:—

Amount of food in cubic centimetres $\times$ $^1/_8$ (saccharated skimmed milk) adds proteids, 0.5 per cent.; and lactose, 1.25 per cent. Amount of food in cubic centimetres $\times$ $^1/_4$ (saccharated skimmed milk) adds proteids, 1 per cent.; and lactose, 2.5 per cent. Amount of food in cubic centimetres $\times$ $^3/_8$ (saccharated skimmed milk) adds proteids, 1.5 per cent.; and lactose, 3.75 per cent. Amount of food in cubic centimetres $\times$ $^1/_2$ (saccharated skimmed milk) adds proteids, 2 per cent.; and lactose, 5 per cent.

Standard sugar solution is prepared by dissolving 10 per cent. of lactose in sterile water, or 2 ounces, by weight, in 20 ounces of water.

In calculating formulæ four facts only are necessary: the quantity of food required; the percentage-formulæ required; that the standards, except the proteids, are 10 per cent.; and the quantity of other constituents introduced with the standards.

With these facts in mind, all that is necessary further is to reduce the quantity expressed in ounces to cubic centimetres by multiplying by thirty, and to multiply this product by one-tenth of the constituent to be introduced. Examples with and without the introduction of extra proteids will be given:—

Single Feeding.

	Fat. Per Cent.	*Proteids.* Per Cent.	*Sugar.* Per Cent.
Quantity, 2 oz. Formula desired .	2.0	0.50	6.00
Oz. $2 \times 30 = 60$ c.cms. $\times 0.2 = 12$ c.cms. decimal cream, adds	2.0	0.50	0.50
Leaves	0.0	0.00	5.50
Oz. $2 \times 30 = 60$ c.cms. $\times 0.55 = 33$ c.cms. sugar solution, adds			5.50

Working formula: 12 c.cms. decimal cream.
33 c.cms. standard sugar solution.
15 c.cms. water.

60 c.cms.

One Day's Food.

	Fat. Per Cent.	*Proteids.* Per Cent.	*Sugar.* Per Cent.
Quantity, 35 oz. Formula desired	4.0	1.0	6.50
Oz. $35 \times 30 = 1050$ c.cms. $\times 0.4 = 420$ c.cms. decimal cream, adds	4.0	1.0	1.00
Leaves	0.0	0.0	5.50
Oz. $35 \times 30 = 1050$ c.cms. $\times 0.55 = 577.50$ c.cms. sugar solution, adds			5.50

Working formula: 420.00 c.cms. decimal cream.
577.50 c.cms. standard sugar solution.
52.50 c.cms. water.

1050.00 c.cms.

One Feeding.

	Fat. Per Cent.	*Proteids.* Per Cent.	*Sugar.* Per Cent.
Quantity, 5 oz. Formula desired	4.0	1.50	7.00
Oz. $5 \times 30 = 150$ c.cms. $\times 0.4 = 60$ c.cms. decimal cream, adds	4.0	1.00	1.00
Leaves	0.0	0.50	6.00
Oz. $5 \times 30 = 150$ c.cms. $\times \frac{1}{8} = 18.75$ c.cms. skimmed milk, adds	0.0	0.50	1.25
Leaves	0.0	0.00	4.75
Oz. $5 \times 30 = 150$ c.cms. $\times 0.475 = 71.75$ c.cms. sugar solution, adds			4.75

Working formula: 60.00 c.cms. decimal cream.
18.75 c.cms. saccharated skimmed milk.
71.25 c.cms. standard sugar solution.

150.00 c.cms.

General Rules for Bottle-feeding.

Age of Child.	Frequency or Interval of Feeding.	Number of Feedings in 24 Hours.	Average Amount for Each Feeding.	Average Amount in 24 Hours.
From its birth until it is 1 month old.	2 hours.	10	1 ounce.	10 ounces.
1 month until 2 months.	Every $2\frac{1}{2}$ hours.	8	$1\frac{1}{2}$ sometimes 2 ounces.	From 12 to 16 ounces.
2 to 4 months old.	Every 3 hours.	6 or 7	From 3 to 4 ounces.	From 18 to 24 ounces.
4 to 6 months old.	Every 3 hours.	6	5 or 6 ounces.	30 or 36 ounces.
6 to 9 months old.	Every $3\frac{1}{2}$ to 4 hours.	5	8 ounces.	40 ounces.
9 to 12 months old.	Every 4 hours.	5	8 ounces.	40 ounces.

Rules for Feeding.

For a Child at Birth. Formula 1.—The newborn infant's food should consist of:—

	Home-modification. To make this formula, we take of		
Fat 1.0	Cream	2	ounces.
Sugar 5.0	Milk	2	ounces.
Proteids 0.75	Lime-water	1	ounce.
Reaction alkaline.	Water	15	ounces.
	Milk-sugar	$6^3/_4$	drachms.

The above formula (1) is to be divided into 10 feedings of 1 ounce each, or 30 cubic centimetres each, and should be heated for 20 minutes to 167° F.

The cream must contain at least 10 per cent. of fat. This is known as a decimal cream, and can be referred to under the heading of "Cream for Home-modification."

Child 1 *Month. Formula* 2.—

	Formula for Home Use. Take of		
Fat 2.0	Cream	4	ounces.
Sugar 5.0	Lime-water	1	ounce.
Proteids 0.75	Water	15	ounces.
Lime-water ..5.0	Milk-sugar	$6^3/_4$	drachms.

The above quantity is to be divided into ten feedings, and heated for 20 minutes to 167° F., and the infant to be fed once every two hours. In Formula 2 we have added more cream and purposely left out the milk. If the infant thrives on this mixture, then we can substitute 1 ounce of milk instead of 1 ounce of water.

After the end of the second month the quantity of food can be increased if the infant's appetite, sleep, stools, and general condition warrant it. Thus, instead of feed-

ing a bottle of Formula 2, we simply add 1 ounce of milk for the third month to Formula 2.

At 4 Months. Formula 3.—

	Formula for Home Use. Take of		
Fat 3.5	Cream	7	ounces.
Sugar 6.5	Milk	1	ounce.
Proteids 1.5	Lime-water	1	ounce.
Lime-water ..5.0	Water	11	ounces.
	Milk-sugar	$6^1/_4$	drachms.

Divide into eight bottles; heat as above to 167° F.: feed every three hours.

From 9 to 12 Months. Formula 4.—

	Formula for Home Use.		
Fat 4.0	Cream	8	ounces.
Sugar 7.0	Milk	$7^1/_2$	ounces.
Proteids 3.0	Lime-water	1	ounce.
Lime-water ..5.0	Water	$3^1/_2$	ounces.
	Milk-sugar	$6^3/_4$	drachms.

The above to be divided into five feedings, heated to 167° F., and one bottle fed every four hours.

Schedule for feeding an average healthy infant from birth upon modified cows' milk, showing percentages of fat, sugar, and proteids, and the daily quantity (Holt), see tables on page 154.

Effect of Heating Milk.

Pasteurizing and sterilizing are still necessary evils. They are really more useful in keeping milk from spoiling than for any other purpose. The diseases transmitted by milk are very few, and are almost invariably due to contaminated water and utensils, and should be obviated

No.	Age.	Fat. Per Cent.	Sugar. Per Cent.	Proteids. Per Cent.	Daily Ounces.	Quantity Grammes
I.	1st and 2d day.	.	5.0	.	4–8	125–250
II.	3d to 7th day.	2.0	6.0	0.60	10–15	310–460
III.	2 to 4 weeks.	2.5	6.0	0.80	20–30	620–930
IV.	1 to 3 months.	3.0	6.0	1.00	22–36	680–1110
V.	3 to 4 months.	3.5	6.0	1.25	28–38	870–1180
VI.	4 to 6 months.	4.0	6.0	1.50	32–38	990–1180
VII.	6 to 9 months.	4.0	7.0	2.00	34–42	1050–1300
VIII.	9 to 12 months.	4.0	6.0	2.50	38–45	1180–1400
IX.	12 to 15 months.	4.0	5.0	3.00	40–50	1240–1550
X.	15 to 18 months.	4.0	5.0	3.50	45–50	1400–1550
XI.	18 months (whole milk).	3.5	4.3	4.00	45–50	1400–1550

Formulæ Obtained by Diluting 12-per-cent. Cream.

		Fat. Per Cent.	*Sugar.* Per Cent.	*Proteids.* Per Cent.
Dil. 5 times with 6-per-cent. sugar sol.:	II.	2.0	6	0.60
Dil. 4 times with 6-per-cent. sugar sol.:	III.	2.5	6	0.80
Dil. 3 times with 7-per-cent. sugar sol.:	IV.	3.0	6	1.00
Dil. $2\frac{1}{2}$ times with 7-per-cent. sugar sol.:	V.	3.5	6	1.20
Dil. 2 times with 7-per-cent. sugar sol.:	VI.	4.0	6	1.30

By diluting five times is meant one part of the cream and five parts of the sugar solution, etc.

Formulæ Obtained by Diluting 8-per-cent. Cream.

		Fat. Per Cent.	*Sugar.* Per Cent.	*Proteids.* Per Cent.
Dil. once with 10-per-cent. sugar sol.:	VII.	4	7	2.00
Dil. $1\frac{1}{2}$ times with 7-per-cent. sugar sol.:	XII.	3	6	1.50
Dil. 3 times with 7-per-cent. sugar sol.:	XIII.	2	6	1.00
Dil. 7 times with 5-per-cent. sugar sol.:	XIV.	1	5	0.50

Formulæ Obtained by Diluting Plain Milk.

		Fat. Per Cent.	*Sugar.* Per Cent.	*Proteids.* Per Cent.
Dil. once with 8-per-cent. sugar sol.:	XV.	1.80	6	2.00
Dil. 3 times with 5-per-cent. sugar sol.:	XVI.	0.90	5	1.00
Dil. 7 times with 4-per-cent. sugar sol.:	XVII.	0.45	4	0.50
Dil. 11 times with 4-per-cent. sugar sol.:	XVIII.	0.30	4	0.34

by dairy inspection. Bacterial growth is what is to be feared in the milk, and this can be prevented by keeping the milk at low temperatures. If the infant's food or milk cannot be kept below 50° F., it should be pasteurized or sterilized as soon as possible, as, while the bacteria are killed by heat, the toxins they produce are not destroyed.

Heating produces many changes in milk, some of which are not thoroughly understood. Boiled milk does not curdle with rennet as easily as raw milk, the cream is about one-third denser than the cream of raw milk, and the albumin is rendered insoluble.

The following table by C. H. Stewart shows the percentage of soluble albumin in milk at various temperatures:—

Time of Heating.	*Soluble Albumin in Fresh Milk.* Per Cent.	*Soluble Albumin in Heated Milk.* Per Cent.
10 minutes at 60° C. (140° F.) . .	0.423	0.418
30 minutes at 60° C. (140° F.)	0.435	0.427
10 minutes at 65° C. (149° F.) .	0.395	0.362
30 minutes at 65° C. (149° F.) . .	0.395	0.333
10 minutes at 70° C. (158° F.) . .	0.422	0.269
30 minutes at 70° C. (158° F.) . .	0.421	0.253
10 minutes at 75° C. (167° F.) .	0.380	0.070
30 minutes at 75° C. (167° F.) . .	0.380	0.050
10 minutes at 80° C. (176° F.) . .	0.375	none
30 minutes at 80° C. (176° F.) . .	0.375	none

Changes in Milk Caused by Sterilization.

In some late experiments made by Dr. E. M. Hiesland and published by Dr. B. C. Hirst[34] Dr. Hiesland found that by sterilization: 1. The albumin is coagulated. 2. Casein less readily precipitated by rennet than in normal milk. Acid corrects this condition. 3. Fat is freed to a slight extent; fat not freed has a lessened tendency

[34] Medical News, January 31, 1891.

to coalesce. 4. Sugar undergoes some change, as shown by its lessened dextrorotatory power. The considerations suggested by a knowledge of the foregoing facts are:—

1. The coagulation of milk-albumin by sterilization may render the milk more difficult of digestion. 2. Sterilization interferes with the coagulability of milk by rennet, and presumably, therefore, with its digestibility by the gastric juice. 3. Free fat, as found in sterilized milk, is probably not readily assimilated in infant-food. The fat not free, being inclosed in a less easily destructible envelope, is probably slow of digestion.[35]

On the question of sterilized milk the weight of evidence seems to show that the process, while preventing undue fermentation, so changes certain of the natural ferments and some of the fats that the milk is less easily digested and less nutritious.[36]

At the New York Medical Association's meeting, March 16, 1891, Brush read a paper on "Sterilized Milk," in which he objected to the sterilization of milk for infants' food because the process devitalized it. Among the other ways in which the value of the milk was lessened by sterilization, he said, was that the soluble albumin was made insoluble. He believed that a child raised on sterilized milk would be less robust, and have a constitution that would more readily succumb to deleterious influences than one fed on natural milk. He contended that every human being required some living food, and that the cause of every scurvy was deprivation of such living food. The sterilization of milk for adults was of but little con-

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[35] Medical Record, February 28, 1891.

[36] North American Practitioner, June, 1892, from the "Year-book of Treatment" (Lea Brothers & Company).

sequence, as they had other kinds of food; but it becomes a matter of the highest importance to an infant whose only food was milk.[37]

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[37] Boston Medical and Surgical Journal, April 9, 1891.

CHAPTER XXII.

Sterilized Milk.

R. G. Freeman, M.D., in a paper read before the Academy of Medicine, New York, May 11, 1893, says, of sterilization, that, when milk is sterilized at 212° F. (100° C.), absolute sterilization is not obtained, but the milk is rendered less digestible than it is in the raw state, and physicians who have used sterilized milk as a regular food find that often infants so fed do not thrive. This clinical experience chemists state is occasioned by the many modifications produced in milk by this temperature of 212° F., the starch-liquefying ferment being destroyed, the casein being rendered less coagulable by rennet and therefore being acted upon slowly and imperfectly by pepsin and pancreatin, and the milk-sugar being destroyed; these chemical changes begin to be marked when a temperature of 176° F. (80° C.) is reached, and become more marked as the temperature becomes higher.

In the Medical Age, September 25, 1893, it is stated that Dr. Fayel, of Caen, France, says boiled milk is more or less indigestible, and is in no respects safer than unboiled milk; the temperature at which milk boils is insufficient to destroy microbes, and the milk is therefore not sterilized, while its density is increased by the boiling above that which is suitable for infant-digestion.

In the Therapeutic Gazette, October 16, 1893, is a translation from a communication to the Société de Médecine de Lyon, by Crolas. Crolas concludes that boiling milk relieves the milk of small quantities of butter, but has no action whatever upon the casein or lactose; that

the boiling increases the quantity of soluble phosphates. He therefore believes that boiled milk as an article of food is equivalent, if not superior, to unboiled milk.

At the meeting of the New York Academy of Medicine, Section in Pediatrics, May 12, 1892, Dr. A. Jacobi, in the discussion upon infant-foods, made the following points:—

It was a great error to suppose that sterilized milk was anything like human milk; it required just as much modification as though it were not sterilized.

Alkalinity in cows' milk was always suspicious, for it was evidence that it had been "doctored." The most dangerous alkali was bicarbonate of soda, for in milk thus treated the ptomaine-producing germs develop best.

While pepsin was sometimes useful, he objected to its indiscriminate use; without an acid it was inert.

Sugar was required in an artificial food, but he did not believe that milk-sugar was best. There was a close relationship between milk-sugar and lactic acid. The change from one to the other was very rapid. Some lactic acid was necessary for proper digestion, but an overquantity produced hyperacidity and indigestion.[38]

Excerpt from an address at the Eleventh International Congress, Rome, Italy, April 4, 1894, by A. Jacobi, M.D.:—

"I shall only dwell upon two articles which have taken an improper hold on the imagination of medical men and have almost been raised into subjects of superstitious veneration. The use of milk-sugar in the place of cane-sugar in children's food, to any extent beyond what there is in cows' milk or its exclusive employment is a

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[38] Virginia Medical Monthly, June, 1892.

source of acid gastric catarrh, which afterward requires medicinal correction; it is transformed into lactic acid beyond need and proves a detriment, to the full conviction of all those who will give the subject proper attention. Thoughtful experience is as valuable an objective addition to our knowledge as a mere chemical or theological theory.

"Next in order is sterilized milk, on which hundreds of thousands of babies are now being fed to the exclusion of everything else. Nobody would teach nowadays the feeding on unchanged or unmixed cows' milk to babies as a proper course to take,—as a substitute for mothers' milk. But sterilized milk has been looked up to as an object of faith and treated as a pope among foods, infallible. To feed babies exclusively on sterilized milk has become the rage since it was recommended by gentlemen of the highest possible standing in science, but, as far as I know, little conversant with the art of treating well and sick infants. I speak so bluntly because I love babies, one and all.

"Sterilized milk—pasteurized is inferior to it—is superior to unchanged cows' milk, still not human. Of 7 cases observed this winter of infantile scurvy,—a nutritive disorder as far as we can make out,—there were 3 that had been fed, 2 exclusively, 1 for several months, on sterilized cows' milk."[39]

The Chemical and Physiological Changes in Milk Caused by Boiling.[40]

Milk consists of a multitude of cells suspended in serum. The cells are fat-cells, which form the cream; the

[39] Medical Record, May 19, 1894.

[40] J. L. Kerr, M.D., C.M., F.R.S.E., in the British Medical Journal, December, 1895.

remaining cells are nucleated, and of the nature of white blood-corpuscles. The serum consists of water, in which is dissolved milk-sugar and serum-albumin, with various salts, and, chief of all, casein. The cells, with the exception of the fat-corpuscles, are all *living cells,* and they retain their vitality for a considerable time after the milk is drawn from the mammary gland.

There is reason for supposing that, when fresh milk is ingested, the *living cells* are at once absorbed without any process of digestion, and enter the blood-stream and are utilized in building up the tissues. The casein of the milk is digested in the usual way of other albuminoids by the gastric juice, and absorbed as peptone. There is also absorption of serum-albumin by osmosis. The chemical result of boiling milk is *to kill all the living cells* and to coagulate all the albuminoid constituents. Milk after boiling is thicker than it was before.

The physiological results are that all the constituents of the milk must be digested before it can be absorbed into the system; therefore there is distinct loss of utility in the milk, because the living cells of fresh milk do not enter into the circulation direct as living protoplasm, and build up the tissues direct, as they would do in fresh, unboiled milk. In practice it will have been noticed by most medical practitioners that there is a very distinctly appreciable lowered vitality in infants which are fed on boiled milk. The process of absorption is more *delayed and the quantity of milk* required is distinctly *larger* for the same amount of growth and nourishment of the child than is the case when fresh milk is used.

Pasteurization of Milk.

Heating milk to 75° C., as is done by many of the methods, does not sterilize, for the spores of the bacillus subtilis can withstand this temperature for several days. The spores will resist the temperature of 100° C. (212° F.) for six hours. Upon heating to 110° to 120° C. (230° to 248° F.) the milk will be thoroughly sterilized, but such heating causes a browning of the milk, and the cream-cells are apt to be broken and the fat or butter will rise to the surface.[41]

Pasteurization with a temperature between 70° and 80° C. (158° to 176° F.) destroys tubercle bacilli and, according to Van Geuns, destroys also the typhoid bacillus, the cholera bacillus, and the pneumococcus of Friedländer, and also most of the ordinary milk germs, and does not injure the milk.[42]

Sterilized Milk.

Sterilized milk is, according to Marr,[43] as badly borne in children's dyspepsias as ordinary milk, for, even when sterilized by Soxhlet's apparatus, milk is still prone to decomposition, and hence favors the decomposition-processes present in the diseased digestive tract.

Dr. B. Bendix[44] studied the question as to the relative value of sterilized and unsterilized milk. In a paper recently published he arrives at the following conclusions: Sterilized and unsterilized milk have an equal value in nourishing both sick and well children. The change in

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[41] Molt-Zeitung.

[42] Medical Record, July 2, 1892.

[43] London Medical Recorder.

[44] Jahrbuch für Kinderheilkunde, 38.

taste and odor caused by the sterilization is no cause for the refusal of the same by infants, as sterilization destroys both the pathogenic bacteria, as well as the bacteria causing fermentation and decomposition; so he believes that it is the duty of every physician to insist on substituting sterilized milk when breast-milk cannot be had, and, as he believes that sterilization does not cause difficulty of digestion, he prefers the latter to pasteurized milk.

Koplik[45] studied the comparative value of sterilized, pasteurized, and other milks, and found that some weeks pasteurized milk and other weeks a sterilized milk would show advantages which, however, would hardly decide for or against either method of preparing the food. The author believes that it is rather the food that should be looked after than the method of feeding it.

Sterilization of Milk at 212° F. for Thirty Minutes.

METHOD OF STERILIZING (SOXHLET METHOD).

Bottle-cleansing.—Always cleanse the bottles thoroughly before using if they are new bottles. It is a good plan to give them one good washing by adding a pinch of common washing-soda to each bottle, boiling for at least five minutes in this soda-water, and then boiling for at least a quarter of an hour in ordinary water. The bottles are then turned upside down to allow the water to drain off. I then insert a large stopper consisting of non-absorbent cotton (ordinary cotton, from a dry-goods store, which is non-absorbent, is far better than the white absorbent cotton). The neck of the bottle is stoppered at least three-quarters of an inch.

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[45] New York Medical Journal, April 13, 1895.

Bottle-baking.—If we wish to dry them hurriedly. then several of these bottles can be placed in a large fry-

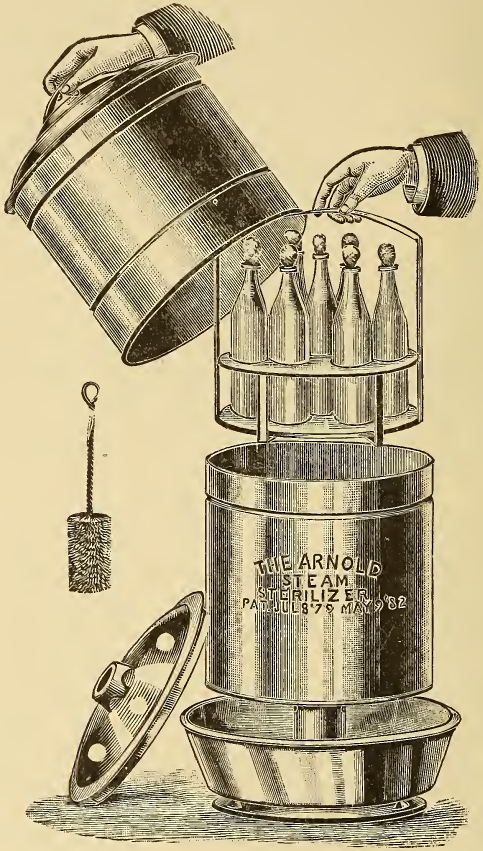

Fig. 20.

ing-pan with a piece of pasteboard between each bottle, and baked *thoroughly dry* for about a half-hour. This not only dries them, but baking them really sterilizes them.

Place the bottles—previously filled with milk or the feeding mixture—in the rack, and set the rack in the sterilizing chamber, and cover up tight with the lid and hood.

Fill the reservoir (pan) two-thirds full of water and place the apparatus over a moderate fire for one hour. If the milk is just from the cow, 40 or 50 minutes are sufficient (20 minutes for heating and 20 or 30 minutes for sterilizing).

The sterilizer may be used on a gas-stove (turned low), kerosene-stove, or upon an ordinary cooking-stove; if over the last, the griddle should not be removed. You can tell by a bubbling sound that the sterilizer is working

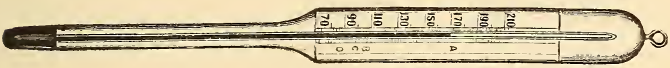

Fig. 21.

all right. If the water is not bubbling with regularity inside, you need more heat. It must not be put on the fire without water in the reservoir, and the water should never be allowed to get lower than one inch from the bottom.

With proper attention as to the quantity of water in the reservoir no further care need be given to the apparatus, or to the contents of the chamber, for the prescribed time.

It is not necessary to place the bottles on ice after removing them from the sterilizer, but all bottles should be put into a refrigerator until taken out for feeding, leaving in the cotton plugs until it is feeding-time. The directions sent out with some sterilizers, that milk will keep for days, implies that infant's milk may be prepared for

several days at once. To this I decidedly object. A great many authors have pointed out cases of Barlow's disease due to milk which had been sterilized and not used for a very long time. Before feeding, the bottle is to be properly warmed by putting it into a small measure or bottle-holder and heating it with alcohol or gas to about the body-temperature of 98° or 100°. Immediately before using shake the bottle, so as to mix the cream and the milk, which invariably separate in a refrigerator; remove the cotton and draw on the nipple.

CHAPTER XXIII.

Pasteurized Milk.

Booker states that certain germs may not be harmful to the baby, if introduced into its body, but are injurious to the milk. For example, bacillus lactis aërogenes. These germs are destroyed at a low temperature. Booker does not believe that the disturbances claimed to be caused by the sterilization of milk are warranted; nor does he believe that sterilized milk *per se* causes scurvy.

Freeman states that high-temperature sterilization causes chemical changes in milk:—

Change in taste at....................70° C. (158° F.).
Chemists note changes at about........80° C. (176° F.).

Freeman believes bottle-food to be a predisposing cause of scurvy. He states that a low temperature, prolonged, acts as well in destroying pathogenic germs as the action of a high temperature for a short time. He advises 68° C., equivalent to 155° F., for 30 minutes, followed by rapid cooling. Such a temperature will destroy the germs of diphtheria, typhoid, and tuberculosis, and other germs, proved by the inoculation of a plate at laboratory temperature, showing no growth after twenty-four hours. Freeman does not believe that our present dairy can furnish a raw milk which is absolutely safe as an infant-food, because, he says, milk must be obtained by pressure on the teats of a cow, and these teats hang beneath an udder, which is covered with hair, and from the belly of the cow, which is also covered with this same hair covering. Moreover, this portion of a cow is particularly liable to be

soiled with dirt, as it comes in contact with the ground when the cow lies down. Its hairy covering, moreover, holds the dirt, which is gradually shaken out by friction. If the cow has loose stools, these run down the inner surface of the thigh and the posterior portion of the udder. The contamination dries on the udder, in the air, and during milking is apt to fall as dust in the pail. Moreover, the milk-ducts of the cow may contain many bacteria, although usually contamination from this source is not very great. Freeman further says: "The milkman's hands are almost never clean. His hands are employed in handling manure, and in attending duties involving contamination. Occasionally they are used during the day in waiting on some one sick with a contagious disease, and, when such is the case, the consumers of the milk are apt to suffer."

The author read a paper by Prof. Adolf Baginsky, on "The Milk-supply in the Kaiser and Kaiserin Friedrich Children's Hospital in Berlin," before the Section on Diseases of Children, at Atlantic City, in June, 1900, wherein Baginsky says that, before milking a cow, the stable is cleaned with a damp cloth. All the dirt is removed, and finally the stable is cleaned with water. Prior to milking, the Swiss milkmen are compelled to thoroughly cleanse themselves, giving especial attention to their hands. These are cleaned with soap and brush. Great stress is laid on washing the udder of each animal with warm soap-water, and dried with clean cloths. In this manner the infection with hair and stable-dirt is prevented. The milk is not allowed to remain in the stable until all the cows are milked, but as soon as a pail is filled *it is at once removed to the dairy*, thus preventing the danger of contamination with bacteria, which are found

in the air of the stable, and which are very hard to destroy by sterilization. These are the bacteria of the hay- and potato- bacillus groups. Another vital point is that warm milk easily absorbs the various stable-odors, and frequently has a distinct "stable-flavor."

If what Freeman claims might happen,—namely: the introduction of filth, manure, and fæcal matter into the milk during the milking process,—then it seems to me

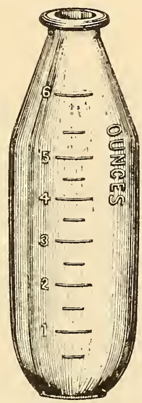

Fig. 22.—Author's Choice of Feeding-bottle.

that such milk should be discarded entirely, for it is hardly conceivable that sterilizing or pasteurizing can modify milk contaminated in such a manner. Following the precepts of Professor Baginsky at Berlin, the main point is to insist on the strictest "stable-hygiene," and thus try to sterilize everything pertaining to the cow, the stable, and the utensils, and in this manner seek to obtain, by the strictest attention to cleanliness, "a strictly-clean milk."

Directions for Pasteurizing Milk. — Pasteurization is really sterilization at a temperature of 167° F. Experience has shown that the bacteria usually found in milk and those which would be harmful for an infant can be destroyed by subjecting milk to a temperature of 167° to 170° F. for 15 to 20 minutes. For this purpose Freeman has constructed his pasteurizing apparatus (see Figs. 23 and 24), which, however, is rather expensive, although extremely useful. The author has used it and has been well pleased with the result.

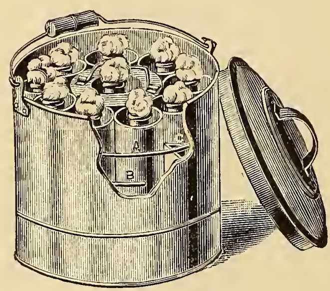

Fig. 23.

Freeman's pasteurizer consists of a metal pail into which a rack is placed holding the bottles exactly as is found in the ordinary sterilizing apparatus. This metal pail is partly filled with water up to its first groove, and the water heated to the boiling-point. Until the water is brought to the boiling-point, the bottles are not introduced within the kettle. The bottles, previously filled with the required mixture of the infant's food, are held in readiness, and, when the water boils in the metal pail, the lid is removed, the rack with the bottles placed on the inside of the metal pail, and the heat turned off, or the

pail is removed from the fire. The process consists in allowing the water to cool, whereby the bottles and the milk get warm for a period of 30 to 45 minutes. After 45 minutes, the lid is again removed, the metal pail containing the bottles of milk are taken to a water-trough or sink, and the cold-water faucet, over which a piece of rubber pipe is fitted, is turned on, and the water permitted to flow on the inside of the pasteurizer. In this way there is a gradual displacement of the warm water by this cold water, until the water is all cold.

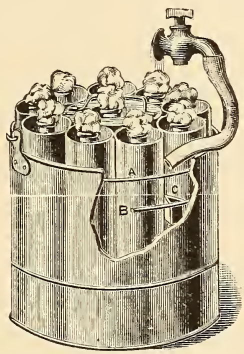

Fig. 24.

After the bottles are sufficiently cooled, they should be removed to the refrigerator. The rapid cooling of the bottles is as important as the pasteurization by the heat. Pasteurized milk should be kept no longer than twenty-four hours. We can pasteurize in other ways with any ordinary sterilizing apparatus. Thus, the Arnold steam-sterilizer (see Fig. 20), leaving the hood off, can be utilized for this purpose. To be sure that we are attaining the correct temperature, we can insert a special thermometer,

which is made for sterilizing bottles. It can be procured from any chemist or from the Arnold Sterilizer Company.

To pasteurize with any ordinary sterilizer, set a thermometer into one bottle and put the sterilizer on a brisk fire until the thermometer reaches 170° F. Then remove to the back of the stove, take out the thermometer, stopper the bottle that contained the same, and cover with a hood or the lid of the tin pail for fifteen minutes. Then fill the inside of the pail with hot water around the bottles as near to the top as possible, remove to the sink, and allow a stream of cold water from the faucet to displace the warm water. A point worth noting is that the cold water must not be allowed to splash on the hot bottles, otherwise it will crack them. It usually takes about ten minutes to gradually displace the hot water in the tin pail or kettle used as a sterilizing chamber, after which the bottles of milk are to be placed in a refrigerator and left there until ready for use. It is understood that each bottle is to be warmed to about a body-temperature of 98° to 100° immediately before feeding.

In a letter recently received by the author Prof. Victor Vaughan says he does not believe that milk is rendered more digestible by sterilization or pasteurization. He thinks that if milk could be obtained under complete aseptic precautions, sterilization, as a preparation for infant-feeding, would not be necessary. However, either sterilization or pasteurization is imperative when market milk is used, because this is seldom or never obtained under aseptic precautions. Some people have an idea that it matters not how filthy a milk is, or how many germs it may contain, if it be pasteurized or sterilized it becomes a fit food for children. This is not true, because, in the

first place, even prolonged boiling does not kill the spores of all bacteria; and, in the second place, the chemical poisons produced by certain germs are not altered by the temperature of boiling milk. After milk has been either sterilized or pasteurized it should be kept at a low temperature before being fed to the child. This should be regarded as a necessary procedure in the preparation of infant-food. The fact that milk in which the colon germ has already grown abundantly cannot, by any process of sterilization or pasteurization, be rendered fit food for children should be emphasized. *The toxin of the colon bacillus may be heated to* 180° *C.* (356° *F.*) *for half an hour without having its poisonous properties diminished.* If clean milk be obtained and pasteurized at from 155° to 158° C. and then kept at a low temperature until fed to the child, it furnishes the best food which it is possible for us to obtain under ordinary circumstances.

CHAPTER XXIV.

TYNDALLIZATION.

WHEN milk is subjected to a temperature of 212° F. for from 15 to 20 minutes on three successive days, such process is called tyndallization. When such a procedure is instituted, we certainly obtain the "absolutest sterility possible" of the milk.

Such milk, however, is not adapted for infant-feeding, owing to the changes brought about by this continued application of heat in rendering the albuminoids and salts contained in the milk more difficult to digest.

Milk subjected to this tyndallization has all the disadvantages of a prolonged sterilized milk or milk-mixture. My experience is decidedly in favor of avoiding such continued heating of milk, and I am sure that many cases of scurvy can be traced to the lack of fresh albumin and casein assimilated.

It is certainly peculiar that in spite of the experience of many noted men, the author has recently seen a decided improvement in a child suffering with scurvy when the food was changed from *sterilized* milk to a raw-milk mixture, the milk-mixture being merely warmed to a feeding temperature.

Barlow's disease can frequently be traced to improper feeding, especially when mothers are permitted to use their experience in making up their own feeding-mixtures. Children are more frequently starved than will be ordinarily admitted, and, were it possible to examine the food given to the average infant and compare it with a standard breast-milk suited for the age of the infant, we would

soon learn that our crude methods resulted in positive harm, the result of which years of proper medication and feeding will hardly be able to remedy.

The vital point to remember is to get the child properly started, and we must not be discouraged if our first feeding-mixture is not properly digested or assimilated. In such instances we will soon learn which elements of our food require more proper modification and elimination, especially so if the stools are studied.

Tyndallization will permit milk to be kept for months, and is just such milk which, fed to weakened children, will ultimately cause Barlow's disease or its allied conditions. While in Berlin several years ago I was given milk which had been sterilized six months previously. While it is true the taste did not betray the length of time that the milk had been kept, it can be easily seen that certain chemical changes will develop, altering the character of the food.

It is my belief, founded on extensive experience, that sterilized milk, continually fed, to the exclusion of raw milk and raw beef-juice, will ultimately result in rachitis or scurvy.

CHAPTER XXV.

Nipples and Bottles.

Attention to this portion of the feeding apparatus is very important, as the cause of sore mouth and tongue

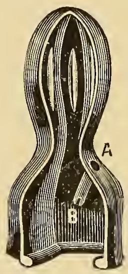

Fig. 25.

and gums can frequently be traced to a filthy nipple. Such infections can be easily avoided in the following

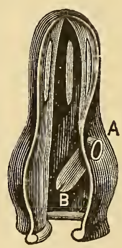

Fig. 26.

manner: The nipples are to be boiled for about ten or fifteen minutes in a so-called nipple-sterilizer (see illustration, Fig. 29), placed in a tin pail of plain water to

which a pinch of salt has been added. After boilng in this manner the nipple should be put into a tumbler of

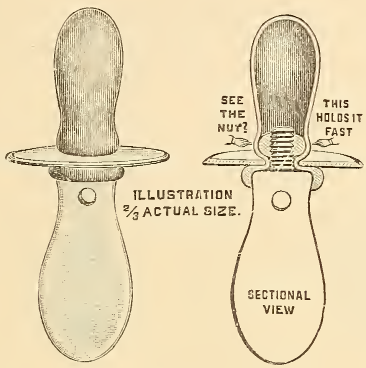

Fig. 27.

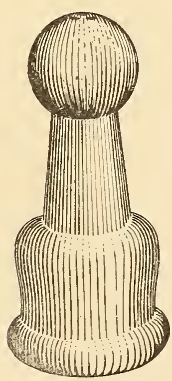

Fig. 28.

plain, sterilized (boiled) water and allowed to soak until it is time to use it. It is advisable to boil every nipple immediately after removing it from the feeding-bottle by

turning it inside out, placing it in the sterilizer, and steaming it for 15 or 20 minutes. In this manner all pathogenic bacteria are destroyed, and all particles of milk which adhere to the rubber are removed. Such nipples will not be the cause of stomatitis or other infectious mouth disorders.

The choice of a nipple is another important matter. My preference has always been for a black-rubber nipple, and it is a very wise point to use a nipple no longer than one week; in other words, old, worn nipples are useless for the proper management of infant-feeding. Black rubber is softer than white rubber; most white rubber is supposed to contain lead; hence a decided reason for not using it.

Nipples Recommended.—One of the best nipples made is the so-called anticolic nipple. This nipple has a ball-shaped top, which enables a baby to take a firm hold; it has three small holes, which give an easy flow of milk, and regulate a slow meal. Nipples having very large openings, which will permit a baby to finish a 6- or 8-ounce bottle of food in five or six minutes, are useless, and *this gulping of food is really the cause, or one of the causes, of infantile colic.* Another nipple I have used, but it is much harder to clean, and, unless all precautions for sterilization are carefully noted, this nipple should not be used; yet, in the hands of the intelligent or where we have a trained nurse, it can be safely recommended. It is called the "Mizpah." The nipple has also a very small puncture; so that the baby gets the food slowly.

The "Swan Bill" nipple or the long French nipple I do not like, nor have I noted results as good as with the above-mentioned kinds.

Ventilated Nipple.—A nipple very highly spoken of

is the ventilated nipple made by Ware, of Philadelphia, which has a small opening or valve on the side, and, as the milk is drawn in from the bottle, it permits air to enter, thus preventing a vacuum from being formed. It is also supposed to be non-collapsible, and is highly recommended

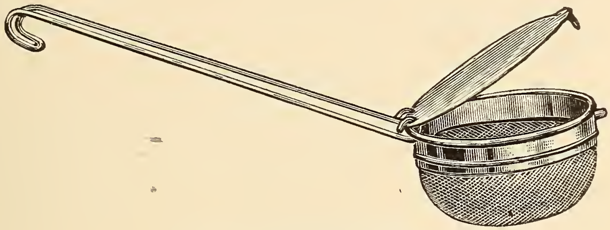

Fig. 29.—Nipple-sterilizer.

by those that have used it. The only objection—already offered—is that all nipples must not only be practical for use, but must be capable of thorough sterilization.

Odor of Nipples.—Children will object most decidedly to nipples having any odor or taste; hence it is a good plan to boil every new nipple before using it.

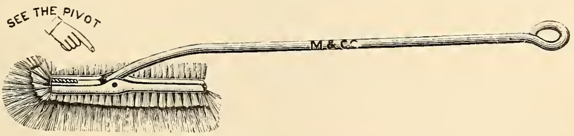

Fig. 30.—Bottle-brush.

The nipple-sterilizer (see Fig. 29) is a very convenient little arrangement made by Ware, of Philadelphia, and resembles a coffee-strainer with a lid. It is neat, cheap, and serves its purpose admirably for the sterilization of the nipple.

The bottle-brush has a long handle and bristles for cleansing the bottles. This brush should be used before the bottles are put in the soda solution, and serves for cleansing the inside of the feeding-bottles. It is self-

Fig. 31.—Bottle-brush.

understood that the *brush can itself harbor bacteria* and particles of milk removed while cleansing. It is therefore important that the brush should be thoroughly boiled in a washing-soda solution after each use.

Fig. 32.

FEEDING-BOTTLES.

The long 8-ounce feeding-bottle, or so-called feeding-tube, which is illustrated, is certainly a unique bottle for feeding; as it has no corners and no useless rims, besides being smooth on the inside, it can be very easily cleaned.

All bottles having angles and depressions should be avoided. The boat-shaped bottle is also very good, but much harder to clean.

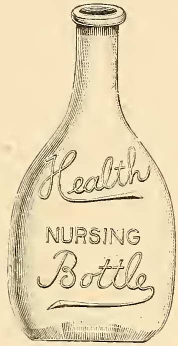

Fig. 33.

My preference has always been for two kinds of bottles: 1. Those holding four ounces and graduated on one side in both ounces and tablespoons. This saves quite

Fig. 34.—Baby-comforter, Not Advised by the Author.

some time and trouble. 2. Bottles holding eight ounces and divided off into 16 tablespoonfuls or 8 equal ounces.

Exactness of Ounces.—It may not be out of place to

ask each physician to insist on having the graduated ounces on an infant's feeding-bottle measured with an *accurate graduate*, obtainable at every drug-store. In many instances the author noted feeding-bottles wherein the ounces were very unequal, and in one particular bottle the eight graduated ounces on the bottle held twelve ounces.

Long Rubber Tubes.—Most prominent pediatrists agree that the long rubber tubes are a convenient place for harboring micro-organisms, and they have been universally condemned.

CHAPTER XXVI.

Dextrinized Gruels.

We have previously referred to the method of making flour ball, in the section on "Additional Foods during the Nursing Period." In some instances, especially where digestion is subnormal, beneficial results will follow the dextrinizing of infant-foods. Thus, the starch of the gruel is held in solution, and the remaining cellulose and proteids of the cereal are left to act on the curds.

Method of Dextrinizing.—Prepare the wheat-, barley-, oatmeal-, or rice- flour by adding a tablespoonful of the same to a pint of water, adding a pinch of salt, and boiling the same for from fifteen minutes to one hour. This will make a gelatinous solution, and hence the name of barley-jelly, rice-jelly, oatmeal-jelly, or wheat-jelly. We allow this jelly to cool, and when cool enough to be tasted we can add a diastase, such as cereo; or taka-diastase, made by Parke, Davis & Co.; or the Forbes diastase. When a small quantity of this diastase is added to the jellies above mentioned, they lose their thickness, and become very thin. They can easily be strained through cheese-cloth, and some water added to make up for the loss by evaporation during the boiling. This jelly, or gruel as it is sometimes called, made from either barley-, rice-, wheat-, or oat- jelly, is to be used with the milk after the diastase is added. In certain diseases, where milk is not well borne, such as dyspepsia (dyspeptic vomiting) or in summer complaint, where the giving of milk is prohibited, feeding the dextrinized gruels for several days will be found, not only very useful, but very healthful. In making this dex-

trinized gruel, small particles will be seen floating, which settle out upon standing. These particles consist of the cell-walls and the proteids of the cereal, and cut the curds of the milk into fine pieces, when the curds begin to shrink under the combined action of rennet and acid. In using this diastase we aim at breaking up the tough curd in cows' milk by purely-mechanical means.

Henry D. Chapin (*Journal of the American Medical Association*, July 14, 1900) says: "The next important step is to get the cows' milk as nearly as possible in the same physical condition as mothers' milk. The diluent I prefer to use is a wheat-, barley-, or oatmeal- gruel, the starch of which has been digested or dextrinized by the action of diastase. A heaping tablespoonful of flour, made from a cereal, is boiled with about a pint and a half of water for fifteen minutes. It is then removed from the stove and set in cold water for about three minutes to cool it. When it is sufficiently cool to taste, a teaspoonful of a preparation of diastase is added, which renders the gruel thin and watery. This makes about a pint of gruel, containing the starches in soluble form, while the cellulose, or skeleton of the cereal, acts as a most effective attenuant of the curd. These digested gruels render the milk-curd porous, and also provoke the secretion of the digestive juices. As diluents, they are a great improvement on water. Most of the thick malt-extracts are sufficiently active in diastase to produce the desired effect." The writer, however, prefers the employment of diastase itself, without any of the other malt ingredients, as being both speedy and efficient. It can either be produced cheaply at home or purchased at the nearest drug-store. A simple decoction of diastase may be made as follows: A tablespoonful of malted barley-grains is put in a cup, and

enough cold water added to cover it, usually two tablespoonfuls, as the malt quickly absorbs some of the water. This is prepared in the evening and placed in the refrigerator over night. In the morning the water, looking like thin tea, is removed by a spoon or strained off, and is ready for use. About a tablespoonful of this solution can be thus secured, and is very active in diastase. It is sufficient to dextrinize a pint of gruel in ten to fifteen minutes. Preparations of diastase are made by a number of chemists: Forbes; Parke, Davis & Co.; Horlick, and others. There is now obtainable an active glycerite of diastase known as cereo, which is specially made for the purpose of dextrinizing gruels.

The author has seen very good results follow the administration of any and all of the malt-extracts now in our market during the past summer, in those critical cases of summer complaint in which subnormal digestion existed.

Frequently the administration of a teaspoonful of malt-extract to an infant immediately before feeding was not only relished by the infant on account of the pleasant taste of the malt, but certainly aided in the assimilation of the food. Rarely was more than 3 teaspoonfuls of malt ordered during twenty-four hours. Such preparations like maltine and also maltzyme gave very good results. The malt-extract of Parke, Davis & Co. has a very pleasant flavor and seems well borne.

Frequently, when expense proved an important item, sufficient dextrinization of foods could be procured with these malt preparations above cited.

It is claimed that, while most malt preparations deteriorate on standing or if exposed too long, cereo will keep indefinitely.

PART II.

CHAPTER XXVII.

Incubator-feeding.

When we consider that the usual viability of a child is placed at twenty-eight weeks of intra-uterine gestation, then we can see how vastly different the method of feeding must be from that of a child born at term, or a so-called "full-born child."

Method of Feeding.—The size of the child precludes the taking of an ordinary-sized nipple, and hence various measures have been tried, the most successful of which have been, according to the author's experience, in feeding with a small medicine-dropper at intervals of two hours, the quantity varying with the age of the infant. It is a good plan, considering the capacity of the infant at term to be 1 ounce, to recognize the deficiency in the development of not only the size and capacity of the stomach, but also its lack of digestive function. Hence my plan has been to commence feeding by giving two teaspoonfuls of milk diluted with two teaspoonfuls of sugar-water; no lime-water and no salt added.

A prematurely-born baby is necessarily doomed without proper food, and there are so many other factors to be considered during its life in an incubator, such as its ventilation, its bodily warmth and cleanliness, that too much stress cannot be laid on the value of its food. Without breast-milk, therefore, I feel justified in saying: I have yet to see the premature infant that will survive, and hence I advise procuring breast-milk, containing no

colostrum-corpuscles, from a woman having a child anywhere from two or three weeks to several months old, and diluting this breast-milk, as stated above, with a solution of cane- or milk- sugar. Voorhees[46] says: "Regarding the care of premature babies in incubators, we have relied mainly on diluted breast-milk, and have only employed cows' milk in weak proportions when it was impossible to obtain the former. In our opinion, our results would have been much poorer without the help of mothers' milk."

In rare instances, where infants are very weak, and seem to doze and will not swallow, a No. 7-American Tiemann & Co. rubber catheter, having a velvet eye, can be attached to a long rubber tube about one foot in length and ending in a little funnel, holding several ounces. (See illustration, Fig. 52.) With this funnel and catheter forced feeding—so-called gavage—can be performed. With the infant lying flat on its back, push the catheter slowly, but forcibly, through the mouth as far against the pharynx as possible, and continue to push the tube from the pharynx into the œsophagus and the stomach. In all, about from five to seven inches, rarely more, will be necessary to reach the stomach. The milk, properly diluted with an equal quantity of milk-sugar solution, can then be allowed to flow in the stomach, and the catheter must then be very quickly withdrawn. Such feeding should be repeated once in four, five, or six hours, depending on the requirements of the case. Each infant is a law unto itself, and hence no cast-iron rule can be laid down, but each individual case should be studied separately and its requirements met as indicated. Thus I have found in a premature infant, born at seven months,

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[46] Archives of Pediatrics, May, 1900.

that 6 drachms was enough for one feeding, and this was well borne once in three hours. The food consisted of equal parts of breast-milk and milk-sugar water. This feeding was continued for one week, when the child cried very much, and, on attempting to satisfy it, the infant swallowed $1\,{}^1/_2$ ounces. We then alternated each feeding by giving a large meal of $1\,{}^1/_2$ ounces followed by a small meal of 6 drachms, and fed in this manner every two hours until the child was three weeks old. We then gave $1\,{}^1/_2$ ounces of food every two hours. The child's stool was quite good; it soiled from two to three napkins every day, and, when it was very restless, we gave it from 2 to 3 teaspoonfuls of boiled water, which seemed to satisfy it. I would urge the necessity of giving plain, sterilized water freely to all infants living in an incubator. The increased temperature of its surroundings calls for it; so does also the necessity for eliminating through skin, bowels, and kidneys.

Dangers of Feeding.—Very small quantities of food should be used in gavage—feedings of the mouth or when feeding through the nose. No more than 4 to 6 drachms should be used, and thus we can feel our way. It is a good point to remember that, the pharynx being very sensitive, the irritation of the tube in passing into the stomach may provoke regurgitation of some of this food, and frequently vomiting will be produced. In such instances, if the posterior nares or the pharynx is filled with food, the infant can easily suck some of this fluid during an inspiration into its trachea, and start up a pneumonia in the same manner as is done during the course of a child having a tube in the larynx in the treatment of laryngeal stenosis.

Rectal feeding for premature infants is rarely called for, but it can and should be tried if the infant will not

swallow and the forced feeding through the mouth or nose is unsuccessful. In such instances use very dilute milk, thoroughly peptonized,—the same proportions, however, as have been stated previously, namely: $^1/_2$ milk and $^1/_2$ water; the formula for rectal feeding should be:—

℞ Breast-milk, $^1/_2$ ounce.
Starch-water, $^1/_2$ ounce.

Add contents of 1 Fairchild peptonizing tube, and inject this quantity with an infant's rectal syringe. (See illustration, Fig. 49.) The starch-water is made by taking 2 teaspoonfuls of ordinary starch and mixing it with $^1/_2$ teacupful of warm water (not boiling water) and making a milky mixture of the same. This starch-water should be made fresh for each feeding. It is advisable to feed about once every six hours with the above solution.

Cleanse the rectum thoroughly by washing with $^1/_2$ pint of lukewarm, Castile-soap water to remove all fæces ten minutes before the nutrient fluid (peptonized milk) is injected.

PREMATURE INFANTS (GRIFFITH).

Premature Birth. — A child may be born in the seventh or eighth month of pregnancy, or even earlier, long before it is quite ready to live outside of the mother's body, and when it weighs not more, perhaps, than two and a half or three pounds. We need not necessarily despair of the life of a baby, however unpromising it seems at first. Children born at six and a half months have grown up strong at last, although it is not often they survive if born before the seventh month. The great need of such a baby is heat, and the maternity hospitals employ an apparatus, called a *couveuse*, *brooder*, or *incubator*, especially devised to supply it. (Fig. 35.) For family use, a

couveuse may be bought at the instrument-makers, or hired from some of them. This is, perhaps, better, as the apparatus is costly. But with an increased degree of attention it may be entirely done without fairly well. If a premature baby is bathed at all after birth, the temperature of the water should be 102° F., and the greatest care should be taken, while drying, to see that the child is not chilled. It should be made very warm by swaddling it in raw cotton, head and all, leaving only the face exposed, wrapping it about with a blanket, and tying it around with a roller bandage. Hot bottles should be placed on each side of it as it lies thus wrapped up in the bed, and fresh ones be substituted frequently. A very convenient method is to place the child in a baby's bath-tub half-full of raw cotton in which numerous hot bottles have been concealed. The child's only clothing consists of a diaper and a shirt. The room should be kept warm, and especially so when this human bundle is unwrapped for its bath. After bathing, it should be rubbed with sweet oil and be rolled up again in fresh cotton. Often it is better to omit all bathing, and simply to rub with the oil.

These premature infants lose considerably more in proportion to their birth-weight than babies at term. This is due to their immature digestive tract; also to the fact that they are almost invariably intensely jaundiced. They gain very slowly, and, if at the end of two or three weeks they have reached their birth-weight, they have done unusually well.

In some of the babies the color is poor from the beginning, and at any time they are especially liable to attacks of cyanosis. For these conditions a little slapping to cause a good cry or the administration of oxygen will dissipate the blueness. Often a few drops of brandy in

hot water every two or three hours will prevent further trouble. One must be very sure, however, that nothing has been aspirated into the larynx.

A great danger in the care of these babies is their susceptibility to infections. The incubator itself is a great germ-carrier, and should be regularly disinfected. The weakness of the lungs and gastro-enteric tract makes the infants especially vulnerable. Unless the air is filtered, dirt is carried in continuously; consequently the streptococcus, staphylococcus, and pneumococcus are always present, seeking an avenue of entrance. Through the skin in eczematous spots or in areas of irritation, at the navel; through the eyes, nose, mouth, larynx, lungs, stomach, and rectum the bacteria can gain admission. To prevent infection the most careful cleansing is necessary, of both the incubator and the baby. Undoubtedly most of the deaths of our cases could be traced to this source.

Finally, in the carrying out of the above essentials in the proper management of the premature infant, we require the most patient and painstaking attention on the part of the nurse, and upon her conscientiousness depends the chance of its survival.

Results.—The statistics are taken from 2314 births which occurred at the Sloan Maternity Hospital before there had been no incubator in use.

Four hundred and ten of these babies were premature, but of these 74 were still-births, which include macerated fœtus, and still-born babies of cases of placenta prævia, accidental hæmorrhage, eclampsia, and the like, leaving 336 for treatment.

Among these cases were a set of triplets, and there were 18 pairs of twins; 85 were treated as infants at term, and of these 4 died,—a mortality of 4 $^{1}/_{4}$ per cent.; 145

were put in cotton, and of these 12 died,—a mortality of 8 per cent. Some of this class should have been placed in the incubator, but for lack of room it was impossible; 106 were incubator babies.

These are divided into two classes: 1. Those that died within four days of birth. 2. Those that lived longer than four days.

Twenty-nine of the incubator babies died within four days. All of these but 3 were more or less asphyxiated at birth; 9 were breech cases, and of these 5 were difficult extractions; 3 after an *accouchement forcé* in placenta prævia. The rest were vertex presentations, but of these 2 were forceps deliveries; 6 were under 7 months of uterine gestation; 22 were between 7 and 8 months along, and 1, $8\,^1/_4$ months.

The etiology of the premature labor was an endometritis in 14; syphilis in 2; albuminuria in 1; placenta prævia in 3; accidental hæmorrhage in 1; persistent vomiting in 1; twin in 1; violence in 1; and in 4 the labor was induced. The largest baby weighed $5\,^2/_{16}$ pounds; the smallest $2\,^7/_{16}$ pounds. Only 5 infants lived over twenty-four hours; 24 were in such poor condition at birth that they survived only a few hours. In 16 autopsies were held, and in all of these there were marked atelectasis; in 7 hæmorrhages of some degree, either into the brain or into the serous membranes; in 2 the foramen ovale was still patent.

Seventy-seven incubator infants survived the first four days; 51 were children of primiparæ, 27 of whom were out of wedlock; 3 infants were under 7 months of gestation, 8 were over 8 months along; 9 were breech presentations; 1 a transverse and the rest vertices; 2 were of triplets associated with albuminuria; 18 were in

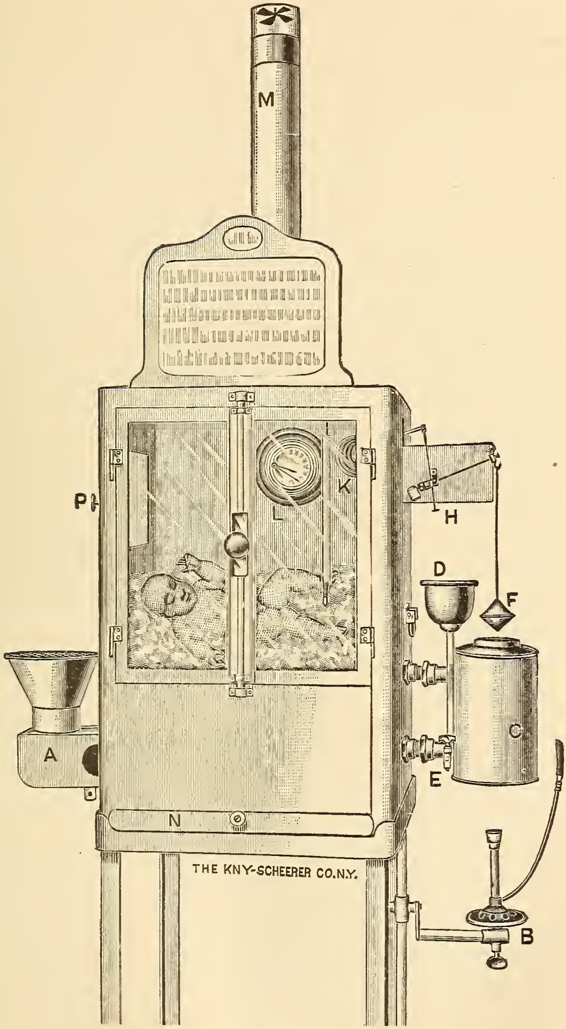

Fig. 35.

twin deliveries, associated with albuminuria or hydramnios. The cause of the premature labor was endometritis in 27; syphilis in 4; phthisis in 2; albuminuria in 7; accidental hæmorrhage in 1; placenta prævia in 1; in 2 the labor was induced for albuminuria and eclampsia; 1 was a Cæsarean section; another an ectopic gestation; the cause of the rest was unknown. Seven were delivered by forceps; 2 by a version; 1 by *accouchement forcé*; 1 by Cæsarean section, and the ectopic gestation by a laparotomy; 12 were slightly asphyxiated at birth; 9 moderately so, and 5 deeply asphyxiated; 2, after one and a half hours' work of resuscitation, were put in the incubator head downward, and their condition was so poor that they were expected soon to die, but they left the hospital gaining in weight; 5 weighed less than 3 pounds; 38 between 3 and 4 pounds; 33 between 4 and 5 pounds; 1 over 5 pounds; the average weight was 3 $^{12}/_{16}$ pounds. During their incubator-life 28 had one or more attacks of atelectasis. All but 10 were more or less jaundiced. The initial loss of the infants was from 1 to 17 $^{1}/_{2}$ ounces; the average was 7 ounces. These figures are not quite correct, as the babies were weighed at different intervals, some on the fifth day, some on the seventh day, and others not till the fourteenth day.

The period of loss was from five to twenty-two days, the average, eleven days; 10 lost steadily till death; one baby was in the incubator only three days, while another lived there eighty-two days. The average time was nineteen days. Some were removed early to make room for others who needed the place more urgently.

Only 3 of the 77 cases vomited. The stools were normal in 32.

One was discharged from the hospital as early as the

eleventh day, and others also too soon at their mothers' demand. One was 89 days old; the average was 24 days.

In 16 diluted breast-milk was supplemented, at times, with a mixture of cows' milk and water, with Russian gelatin and lactose. In 10 a 1, 6, 0.33 modification was used. In all the rest diluted breast-milk was relied upon. Twenty-seven never nursed at the breast: of these, 12 died. A few nursed as early as the third or fourth day two or three times a day. Others not for three weeks, and one not till the sixty-eighth day. Of the 77, 13 died in the hospital: a mortality of 16 per cent. The cause of death was atelectasis and bronchitis in 7, acute asphyxia from a curd in the larynx in 1, syphilitic pneumonia in 1, cerebral hæmorrhage in 1, gastro-enteritis in 3, and a patent foramen ovale and ductus arteriosus in 1. The condition of 3 was poor at time of discharge, fair in 24, and very good in 37; 32 were above their birth-weights, and 57 were gaining in weight. To letters written about January 1, 1900, no answer was obtained from 28. Thirteen were reported as having died, 1 of these lived fourteen months, 1 nine months, 1 four and one-half months, 3 lived two months, 6 lived six weeks, 1 only a month. Five of these died at the Nursery and Child's Hospital, and 2 died at Bellevue Hospital. They were bottle-fed, and the probable cause of death was gastro-enteritis. Twenty-one were found to be *alive* and doing well. Some had nursed and the others were bottle-fed. The oldest baby was twenty-two months, and almost all were good, healthy children. One baby at seven months weighed 16 pounds. It weighed 4 $^1/_{16}$ pounds at birth, and nursed from its mother after leaving the hospital. The ectopic and the Cæsarean babies were in beautiful condition.

Incubators.	Tarnier. Per Cent.	Charles. Per Cent.	Sloane Hospital Per Cent.	At the Sloane Hospital, not counting those which died in a few hours. Per Cent.
Saved at 6 months.	16	10		
Saved at $6\frac{1}{2}$ months.	36	20	22	66
Saved at 7 months.	49	40	41	71
Saved at $7\frac{1}{2}$ months.	77	75	75	89
Saved at 8 months.	88		70	91

The incubator here described (see illustration, Fig. 35) is the one used at the Sloane Maternity Hospital. There are a great variety of these incubators, but the one made by the Kny-Scheerer Company in this city will answer all requirements. Owing to its expense, the manufacturers will lend an incubator for a nominal sum per month.

CHAPTER XXVIII.

Aërated Milk.

Aëration of Milk.—Milk when drawn from the cow contains a certain amount of dissolved gases. These gases contain more or less of what is known as animal odor, the amount of this odor depending very largely upon the physical condition of the animal at the time the milk is drawn. Sometimes the amount is very slight and scarcely noticeable; at other times it is so great as to be extremely offensive. These gases and the accompanying odor are easily removed from the milk by exposure of the milk to the air during the process of cooling, and to this extent aëration of the milk is an advantage. Various forms of aërators and combined aërators and coolers have been devised, many of which are simple and effective, and the best results follow their use. In order to secure these results by aëration, however, it is necessary that the apparatus used for aëration should expose the milk thoroughly to the air, should not be cumbersome, and should be simple and easily cleaned; moreover, the process of aëration should always take place in the purest atmosphere possible.

Certified Milk.

Dr. H. L. Coit organized a medical commission in Newark, N. J., which has made agreements with the dairymen compelling them to look after the details pertaining to the food, the selection of the cows, and—most particularly—the handling of the milk. All this is under the supervision of the Medical Commission. A veterinary

surgeon is employed for the inspection of the animals. In like manner a chemist and bacteriologist see that the milk is kept to the standard requirements of composition and purity. The milk is delivered in bottles, which are labeled "Certified Milk." This plan has proved to be very successful, and certainly deserves imitation.

CHAPTER XXIX.

Infant-foods.

There have been a great number of infant-foods and seemingly a great variety placed upon the market and exploited by the makers as suitable for the artificial feeding of infants.

These infant-foods may be broadly classified under two heads of (*A*) infant-foods in which cows' milk desic-

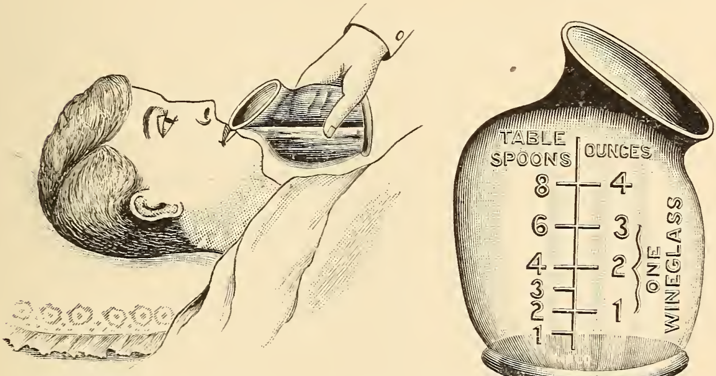

Fig. 36.—Feeding-cup, after Period of Weaning.

cated is a constituent, and (*B*) infant-foods to be used with and as adjuncts to fresh cows' milk.

The infant-foods of which dried milk is a constituent are made from cereals and cows' milk. The milk is desiccated in the process of manufacture, and these foods are commonly known as dried-milk foods, although in this class of foods milk-solids constitute but from one-eighth

to one-fourth the substance of the foods, the balance consisting of matters derived from cereals. In some of these foods the starch of the cereals is untransformed, and they may be termed farinaceous dried-milk foods. In others the starch of the cereals has been transformed into dextrin and maltose, and they may be termed malted dried-milk foods.

All attempts to preserve whole cows' milk by evaporating it to dryness have been failures; the fat of desiccated milk soon acquires a rancid flavor, and the caseous matter does not properly dissolve in water, as the drying process destroys its colloidal condition. In the dried-milk foods the caseous matter of the cows' milk is intimately mixed with the other ingredients, but its colloidal condition has been destroyed, and it is in the form of fine, hard, granular particles, very sparingly soluble in water.

The group of infant-foods used as adjuncts to cows' milk are either farinaceous foods, made from cereals and consisting largely of unconverted starch; or malted foods, also made from cereals, but having the starch transformed into soluble maltose and dextrin. As fresh cows' milk is, without doubt, the best generally-available material for the artificial feeding of infants, the foods of the latter class, used for the modification of fresh cows' milk, are more in accord with physiological principles than are the dried-milk foods.

Of the large number of infant-foods that have been put on the market, it is our purpose to describe a few commonly-known foods. In order to judge fairly of the nutritive value of an infant-food and its resemblance to woman's milk, it is necessary to know its composition after its preparation for the nursing-bottle according to the directions of its manufacturer, and the analyses that

accompany the following descriptions are of the foods prepared for use for infants six months of age as per directions on the packages.

The published analyses of woman's milk show the great variability of its composition, especially as regards the percentages of proteids and fats. The analysis of woman's milk used in the following tables is by Dr. Luff, adopted as the standard by Cheadle. It agrees closely with Leeds's analysis, excepting as to the fat, which is given by Luff as 2.41 per cent. and by Leeds as 4.13 per cent.; the latter amount seems too large, as it considerably exceeds the published averages of a number of observers.

NESTLE'S FOOD.

Nestle's food is a farinaceous dried-milk food of Class A. According to the manufacturers, it is made "from the richest and purest cows' milk, the crust of wheaten bread, and cane-sugar," and is a "form of modified milk." "No cows' milk is to be added to Nestle's food: nothing but water, and that water is boiled."

Upon examination, unconverted starch and cane-sugar are found to be its principal constituents, amounting to about 70 per cent. of the whole. The directions for preparing Nestle's food for the nursing-bottle, for infants six months old, are to use 2 level tablespoonfuls of the food to 1/2 pint of water; mix the food with enough warm water to make a smooth paste that will pour, add the rest of the water and boil in a sauce-pan, stirring constantly until it thickens and a milky foam appears on the top.

	Composition of Nestle's Food,[47] when Prepared as Above.	*Woman's Milk.*
Water	92.76	88.51
Salts	0.13	0.34
Proteids	0.81	2.35
Fat	0.36	2.41
Starch	1.99	
Cane-sugar	2.57	
Maltose, dextrin, etc.	0.44	
Milk-sugar	0.84	6.39
	Reaction alkaline.	Reaction alkaline.

The thick condition of the mixture is owed mainly to the insoluble starch present. The total carbohydrates therein (5.84 per cent.) are somewhat less than the carbohydrate, milk-sugar (6.39 per cent.), in woman's milk; it is to be noted that, of this amount, 1.99 per cent., or about one-third, consists of insoluble starch.

The fat is nearly one-sixth and the proteids are about one-third of the amounts in woman's milk, and over one-half of the proteids is insoluble, owing to the colloidal condition of the milk-casein having been destroyed by drying during manufacture.

HORLICK'S MALTED MILK.

This is a malted dried-milk food of Class A, stated on the circulars to be composed of pure, rich cows' milk combined with an extract of malted grain, and not to require the addition of cows' milk. Its makers claim that, by special treatment with their new agent, plant-pepsin, the casein, or cheesy part, of the cows' milk is kept from forming large and irritating curds in the stomach.

This food is very nearly soluble in water, as its prin-

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[47] According to Chittenden.

cipal constituents are the soluble carbohydrates—maltose, dextrin, and milk-sugar. The drying process has destroyed the colloidal condition of the caseous matter of the milk, and it is in the form of finely powdered, hard particles, sparingly soluble in water.

The directions for preparing the food for an infant six to twelve months of age are to dissolve 4 to 6 teaspoonfuls in $^1/_2$ pint of water. Composition when prepared by using 6 teaspoonfuls of food to $^1/_2$ pint of water:

	Horlick's Malted Milk.[48]	*Woman's Milk.*
Water	92.47	88.51
Salts	0.29	0.34
Proteids	1.15	2.35
Fat	0.68	2.41
Maltose and dextrin	4.20	
Milk-sugar	1.18	6.39
	Reaction alkaline.	Reaction alkaline.

The proteids, fat, and carbohydrates are all less than in woman's milk, the proteids being not quite one-half and the fat not quite one-third of the amounts in woman's milk. The amount of milk employed must be very small in proportion to the cereal constituents, since the mixture, prepared as above, corresponds to a dilution of 1 part of good cows' milk with about 4 parts of water.

MILKINE.

This is a malted dried-milk food (Class A). Its makers state it is a complete food ready for immediate use by the addition of water, and the only prepared food that combines the nutritive elements of meat, milk, and cereals.

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[48] According to Chittenden.

In this malted dried-milk food beef-extract is combined with cereal extractives and dried milk. Soluble carbohydrates are its principal constituents, forming nearly three-fourths of the product. The proteids are sparingly soluble.

The directions for preparing milkine for an infant three to six months of age are to dissolve 1 to 2 dessertspoonfuls of food in a breakfastcupful of water.

Composition when prepared with 2 dessertspoonfuls in a breakfastcupful of water:—

	Milkine.	*Woman's Milk.*
Water	92.78	88.51
Salts	0.23	0.34
Proteids	0.92	2.35
Fat	0.43	2.41
Maltose, dextrin, etc.	4.74	
Milk-sugar	0.90	6.39
	Reaction alkaline.	Reaction alkaline.

The total solids are hardly two-thirds of the amount in woman's milk. The fat especially is greatly deficient, being only about one-sixth of the amount in woman's milk, and the proteids are but two-fifths of the amount in woman's milk.

A dilution of 1 part of good cows' milk with about 7 parts of water will contain about the same amount of milk as milkine prepared as above.

CEREAL MILK.

Cereal milk is a malted dried-milk food (Class A). It is stated by its makers to be a complete food, cooked and ready for use with the simple addition of water, and to be made from the purest Vermont dairy-milk, the finest wheat-gluten flour, the best barley-malt, and milk-sugar.

Cereal milk in general appearance very much resembles the other malted dried-milk foods. but it contains a much greater percentage of milk-sugar, showing that this substance is used in its manufacture, as claimed.

The directions for preparing it for use are to mix 1 teaspoonful of cereal milk in a teacupful of hot water for infants under three months of age or for a very delicate child. For older and stronger children 1 to 2 teaspoonfuls of food are to be used to each cupful of water. Composition when prepared by using 2 heaping teaspoonfuls of food to a teacupful of water:—

	Cereal Milk.	*Woman's Milk.*
Water	92.52	88.51
Salts	0.16	0.34
Proteids	0.69	2.35
Fat	0.30	2.41
Maltose, dextrin, etc.	4.73	
Milk-sugar	1.60	6.39
	Reaction alkaline.	Reaction alkaline.

The total of soluble carbohydrates as above is practically the same as in woman's milk; the amount of proteids is less than one-third the amount in woman's milk, and about one-half is insoluble in water. The amount of fat is one-eighth the amount in woman's milk. The small amount of fat indicates that the cereal extractives and milk-sugar make up the bulk of the solids of this food, and that a dilution of 1 part of good cows' milk with 11 parts of water would be the counterpart of the above mixture as to the amount of milk therein.

WAMPOLE'S MILK-FOOD.

Wampole's milk-food is a malted dried-milk food (Class A). Its makers state that it is made from malted

cereals, beef, and milk, and when mixed with warm water it is immediately ready for use; no other preparation necessary.

This dried-milk food is very nearly soluble in water, owing to the soluble carbohydrates being so large a constituent. A little less than one-half of the proteids is insoluble in water. A small amount of beef-extract has been combined with the cereal extractives and dried milk.

To prepare it for an infant six months to one year of age, the directions are to dissolve 4 to 6 teaspoonfuls of the food in 6 ounces of hot water. Composition when prepared by dissolving 6 teaspoonfuls in 6 ounces of water:

	Wampole's Milk-food.	*Woman's Milk.*
Water	88.59	88.51
Salts	0.46	0.34
Proteids	1.58	2.35
Fat	0.73	2.41
Maltose, dextrin, etc.	7.65	
Milk-sugar	0.99	6.39
	Reaction alkaline.	Reaction alkaline.

Compared with woman's milk it is seen that the carbohydrates are considerably in excess, and the proteids and fat are deficient, the fat especially, it being less than one-third the amount in woman's milk.

One part of good cows' milk diluted with about $3\,^1/_2$ parts of water would be analogous to the dilution of milk in Wampole's milk-food prepared as above.

IMPERIAL GRANUM.

Imperial granum is a farinaceous food to be used as an adjunct to cows' milk (Class B).

Its makers state that it is a solid extract derived from very superior growths of wheat, nothing more. It ap-

pears to be made as claimed from wheaten flour and to be mainly composed of torrefied starch.

For an infant six months of age it is to be prepared by cooking 3 1/2 teaspoonfuls of food in 21 ounces of water and 20 ounces of milk.

Composition when prepared as above:—

	Imperial Granum.[49]	*Woman's Milk.*
Water	91.53	88.51
Salts	0.34	0.34
Proteids	2.15	2.35
Fat	1.54	2.41
Starch	1.22	
Maltose, dextrin, etc.	0.58	
Milk-sugar	2.71	6.39
	Reaction alkaline.	Reaction alkaline.

The total of solids contained is one-quarter less than in woman's milk; the carbohydrates are nearly one-third less than the amount in woman's milk and it should be observed that 1.22 per cent., or about one-fourth of them, consist of starch; there is only a slight deficiency in the amount of proteids, but a considerable deficiency in the amount of fat. By using more milk or milk and cream and less water than above employed the percentages of fat, proteids, and soluble carbohydrates would be increased.

Its very large proportion of starch forms the principal objection to this food.

The presence of unconverted starch causes the thick condition of the mixture.

ESKAY'S ALBUMENIZED FOOD.

This food is to be prepared with cows' milk (Class B).

Its makers state that it contains the more easily digested cereals combined with egg-albumin.

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[49] According to Chittenden.

Eskay's albumenized food consists largely (about 88 per cent.) of carbohydrates; the soluble carbohydrates, mostly milk-sugar, are about 50 per cent. and the insoluble carbohydrates, mostly starch, are a little less than 40 per cent. On account of this large proportion of starch it may be termed a farinaceous food.

It contains about 5 $^1/_2$ per cent. of proteids, and they are almost entirely insoluble in water.

If, as claimed, egg-albumin is a constituent of the food, it is apparently coagulated and made insoluble in the process of drying. However, did the product contain egg-albumin carefully desiccated and soluble, it would be coagulated and rendered insoluble in preparing the food for use, as the temperature directed to be employed is considerably above that at which normal egg-albumin is coagulated.

The directions for preparing it for an infant from six to twelve months of age are to cook 3 tablespoonfuls of the food in 2 $^1/_4$ pints of water and 9 tablespoonfuls of cows' milk and add thereto 6 tablespoonfuls of cream. Composition when prepared as above:—

	Eskay's Albumenized Food.	*Woman's Milk.*
Water	92.16	88.51
Salts	0.16	0.34
Proteids	0.85	2.35
Fat	3.11	2.41
Starch	1.03	
Dextrin, etc.	0.47	
Milk-sugar	2.22	6.39
	Reaction alkaline.	Reaction alkaline.

The total carbohydrates are three-fifths of the amount in woman's milk; of these nearly one-third is un-

converted starch. The proteids are greatly deficient, being only two-fifths of the amount in woman's milk. The fat, from the use of so much cream, is somewhat in excess. The prepared food, it is to be seen, falls far below woman's milk in its nutritive constituents.

MELLIN'S FOOD.

Mellin's food is a malted cereal food (Class B). This food is stated by its makers to be a soluble dry extract from wheat and malt, for the modification of fresh cows' milk.

The carbohydrates therein are in the form of dextrin and maltose, and constitute about 80 per cent. of the food; the proteids amount to about 10 per cent., and are derived from the cereals. Mellin's food is almost completely soluble in water. It is especially noticeable that this food does not contain any starch.

The directions for preparing this food for use for infants six months of age and over are to dissolve 2 heaping tablespoonfuls of food in $^1/_4$ pint of hot water and $^3/_4$ pint of cows' milk.

Composition when prepared as above:—

	Mellin's Food.[50]	*Woman's Milk.*
Water	88.00	88.51
Salts	0.47	0.34
Proteids	2.62	2.35
Fat	2.89	2.41
Maltose, dextrin, etc.	2.73	
Milk-sugar	3.25	6.39
	Reaction alkaline.	Reaction alkaline.

In total solids this food differs but slightly from woman's milk, and in the various constituents its simili-

[50] According to Chittenden.

tude to woman's milk is remarkably close. Of the carbohydrates the maltose and dextrin are a little less in amount than the milk-sugar, and the total carbohydrates (5.98 per cent.) are only slightly less than the amount in woman's milk.

The manufacturers of Mellin's food present many formulas for preparing the food for use to meet various indications. The following formulas are given with the analyses of the respective milk-modifications:—

Formulæ and Analyses for Preparing Mellin's Food.

For Infants about Two Months Old.

Mellin's food, 6 teaspoonfuls (level). Milk, $6\frac{1}{2}$ fluidounces. Water, $9\frac{1}{2}$ fluidounces.	Gives this composition:	Water .... 93.40 Salts .... 0.35 Proteids .... 1.69 Fat .... 1.53 Carbohydrates (no starch) 3.03

Low Proteids.

Mellin's food, 2 tablespoonfuls (heaping). Milk, 4 fluidounces. Cream, $1\frac{1}{2}$ tablespoonfuls. Water, 12 fluidounces.	Gives this composition:	Water .... 91.50 Salts .... 0.37 Proteids .... 1.45 Fat .... 2.50 Carbohydrates (no starch) 4.18

High Fat and Low Proteids.

Mellin's food, 3 tablespoonfuls (heaping). Milk, 4 fluidounces. Cream, 2 tablespoonfuls. Water, 12 fluidounces.	Gives this composition:	Water .... 89.36 Salts .... 0.45 Proteids .... 1.65 Fat .... 3.00 Carbohydrates (no starch) 5.54

PEPTOGENIC MILK-POWDER.

This product is stated by its makers to be an article containing milk-sugar and a digestive ferment capable of acting on casein, offered for the preparation of an artificial infant-food. McGill states: "It is not, in the strict sense, a food. Its professed object is so to change the composition of cows' milk as to render this comparable to human milk. This it seeks to do by introducing milk-sugar and small quantities of albuminoids." According to McGill's analysis, it is composed almost entirely of milk-sugar (96.60 per cent.).

The following analysis is by Leeds, and is taken from a circular of the makers.

Composition of "humanized milk" prepared as directed, using 4 measures of peptogenic milk-powder with $^1/_2$ pint of milk, $^1/_2$ pint of water, and 4 tablespoonfuls of cream:—

	Humanized Milk.	*Woman's Milk.*
Water	86.20	88.51
Ash	0.30	0.34
Proteids	2.00	2.35
Fat	4.50	2.41
Milk-sugar	7.00	6.39
	Reaction alkaline.	Reaction alkaline.

Chittenden's analysis of this "humanized milk" is almost identical with the above.

The proteids of the cows' milk undergo a change in the peptonizing process, being converted chiefly into partial peptones, and in this form they cannot be said to resemble the proteids of woman's milk, which have not been acted upon by a proteolytic ferment.

CHAPTER XXX.

Condensed Milk.

As condensed milks are very widely employed for the artificial feeding of infants, the analyses of a few well-known brands are given prepared for this purpose by diluting with water. These condensed milks contain large amounts of cane-sugar, added on account of its preservative qualities.

The directions on the tin of the Anglo-Swiss Condensed Milk Company's Milkmaid Brand of condensed milk are, for newborn infants, add 14 parts of water; as the child grows older, gradually use less water, but never less than 7 parts.

The analyses of all these condensed milks are of the milk diluted with both 7 parts and 14 parts of water—the two extremes.

	Milkmaid Brand.		*Gail-Borden Eagle Brand.*	
	With 7 Pts. Water.	With 14 Pts. Water.	With 7 Pts. Water.	With 14 Pts. Water.
Water	88.18	93.59	89.10	94.09
Ash	0.36	0.19	0.29	0.16
Proteids	1.50	0.82	1.31	0.71
Fat	1.70	0.92	1.18	0.64
Cane-sugar	6.00	3.25	6.59	3.57
Milk-sugar	2.26	1.23	1.53	0.83

	Nestle's Swiss Milk.		*Woman's Milk.*
	With 7 Pts. Water.	With 14 Pts. Water.	
Water	87.95	93.46	88.51
Ash	0.25	0.14	0.34
Proteids	1.51	0.82	2.35
Fat	2.14	1.16	2.41
Cane-sugar	5.81	3.15	
Milk-sugar	2.34	1.27	6.39

The foregoing brands of condensed milks are considered to be among the best upon the market.

Professor Gaertner Mother-milk.

In a paper entitled "The Clinical Value and Chemical Results" the author published a paper in the *Medical Record*, December 11, 1897. This new food has now been used about five years in Europe, and is the outcome of the scientific endeavors of Professor Gaertner, of the University of Vienna. The first paper was published by Gaertner in the *Therapeutische Wochenschrift*, May 5, 1895.

A few months before, January, 1895, Gaertner, in an address before the Vienna Scientific Society, explained the mode of preparation and the results obtained with his new modification of cows' milk, for such the mother-milk of Gaertner really is. Professor Gaertner, in the preparation of his food, has aimed to overcome what has been the great difficulty in infant-feeding—namely: to reduce the excess of casein by a scientific process without the addition of chemicals.

To achieve this result he employs a machine called a separator or *pfanhauser* centrifuge, which makes four thousand or eight thousand revolutions per minute. The apparatus consists essentially of a drum of steel, which revolves on its axis. This drum is filled with equal parts of fresh cows' milk and sterilized water. The mixture contains approximately the same amount of casein as human milk, for cows' milk undiluted contains about twice as much casein as human milk. The mixture is next poured into the centrifuge and the speed of the drum is carefully regulated, so as to separate the mixture contained therein into (1) a creamy (fatty) milk and (2) a skimmed milk.

The two portions so separated are then led off separately by suitable openings in the centrifuge.

The analysis of each of these portions shows that the creamy milk has the same quantity of fat as is found in human milk, while about 2 per cent. of the casein is contained in the skim-milk, and the remainder, about 1.7 per cent., remains in the creamy milk. The chemical composition of fat milk is shown in the following table:—

	Proteid.	*Fat.*	*Sugar.*	*Ash.*
Fat milk..................	1.76	3-3.5	2.5	0.35
Human milk...............	1.03	3.5	7.03	0.21
Cows' milk diluted with one-half water...............	1.76	1.6	2.5	0.35

If, now, 3 or 4 grammes of milk-sugar be added to every 100 cubic centimetres of fat milk, the percentage of sugar is brought up to the level of sugar in human milk. This addition is made before sterilizing. The fat milk has the advantage over the diluted milk of having "a higher percentage of fat," and also it curdles more slowly than diluted milk and the curd forms a more flocculent precipitate.

According to Escherich, the following amounts should be used at different ages of infancy, feeding every two to four hours:—

Infants under 2 weeks....	500 c.cms.	($17\frac{1}{2}$ ℥)	in 9 feedings.
Infants 3 to 4 weeks.....	750 c.cms.	(26 ℥)	in 8 feedings.
Infants 4 to 8 weeks.....	1,000 c.cms.	(35 ℥)	in 8 feedings.
Infants 3 to 4 months....	1,250 c.cms.	(42 ℥)	in 8 feedings.
Infants 5 to 6 months....	1,500 c.cms.	(50 ℥)	in 7 feedings.

Escherich gives in detail his experience in feeding with fat milk fifty infants in a hospital, including rickety and tuberculous children. He has certainly met with

marked success. Some cases have been under observation for six months. His article is published *in extenso* in *Mitteilungen des Vereins der Aerzte in Steiermark,* No. 1, 1895.

Baginsky[51] mentions Gaertner milk as a new form of food introduced. In our country Jacobi[52] states that Gaertner milk is applicable to the majority of infants who require cows' milk appropriately prepared.

During the last summer I proposed to test the efficacy of Gaertner milk. With this view I have subjected the milk to a very rigid test, inasmuch as the time chosen, from June to October, was the heated term, which is the worst for milk digestion, and the hygienic conditions of the infants were those found in the average tenement-house, too well known to need description.

The guides for ascertaining the degree of assimilation were the following factors:—

1. The child's general condition, as manifested by its appearance, appetite, and sleep.

2. The presence or absence of gastro-enteric disturbances, such as vomiting, colic, restlessness.

3. The condition of the stools, constipation or diarrhœa, the number of stools in twenty-four hours.

4. The gain in weight; weekly observations.

The nurses or mothers were instructed to note the amount of food taken and the number of stools in twenty-four hours.

We submitted the stools passed in twenty-four hours to Mr. Herman Poole, our chemist, whose chemical re-

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[51] "Lehrbuch der Kinderkrankheiten," fifth edition, pages 35 and 36.

[52] "Therapeutics of Infancy and Childhood," page 508.

port is appended. Thus we have tried to ascertain how much proteids, fat, sugar, and salts were taken, how much absorbed, and how much was voided in the fæces without having taken part in metabolism.

The following cases will serve to illustrate the method pursued in attempting to solve the problem before us and the results obtained as regards the efficacy of the milk:—

Case I.—Dorothy Shattuck, a prematurely-born child, the labor having occurred in the middle of the eighth month of gestation. For three weeks after birth the child's mother fed her on Borden's "eagle brand" condensed milk, and then, being discouraged with the results, gave the child to the care of Mrs. Turnure, who brought her to the clinic. For the past week she had fed the child on malted milk and a mixture of milk, cream, and barley-water. June 16, 1897, the little patient first came to us at the German Poliklinik. She stated that the child had been getting worse, was extremely irritable, slept badly, had had persistent vomiting and diarrhœa, with six and more watery stools daily. It also had a hacking cough.

Status præsens: An extremely-emaciated child, twelve weeks old, weighing 6 pounds and 12 ounces. The head is of normal shape; the face has a peculiar, senile expression; the fontanelles are open, but do not bulge. The scalp is of a reddish color, with here and there a furuncle. The face has a sallow, earthy color; the eyes are kept closed most of the time. The thorax is not deformed; the ribs are not beaded; the thoracic skeleton is sharply outlined; the skin is dry, yellowish. The upper extremities show thick epiphyses; thin, flabby, bluish skin; cold, weak hands; and thin, atrophic long bones. The reflexes are diminished, the grasp is weak. The abdomen is full and pendulous, the abdominal walls are very thin, the intestines are distended with gas. The skin in the groins is flabby; there are no dilated veins and no herniæ. The buttocks and genitals are covered with an erythematous rash (intertrigo); the anal reflex is normal; rectal temperature, 99° F. The lower limbs are similar to the upper—thin bones, thick epiphyses, atrophic muscles, bluish dry skin. The scapulæ project

behind; the spine is not deformed; the whole appearance is one of extreme atrophy. The tongue has a white coating; gums normal; *fœtor ex ore.* There are swollen glands in the inguinal region and furuncles on the thighs. The child drinks water with avidity; a peculiar, lactic-acid smell is exhaled from the body.

Diagnosis: Athrepsia, catarrhus gastro-entericus, rachitis.

Treatment: (*a*) Hygienic: Daily baths; cleanliness in the mouth, clothing, bottles, nipples.

(*b*) Dietetic: The sole diet, Gaertner's mother-milk. Three cans (one-third litre in each) in twenty-four hours; beginning with a few ounces at a time, and increasing the dose gradually until 8 ounces are given at one meal, of which there should be six in twenty-four hours: *i.e.*, every three hours in the day-time and at longer intervals at night.

(*c*) Medicinal: None.

An irrigation with hot water was used to wash out the colon and rectum before the diet was begun.

June 23d, the child took the milk at first reluctantly; the first doses were vomited at once. The nurse persisted, however, and her efforts were rewarded, for in a few hours the baby began to take the milk in larger quantities and to retain it well. The vomiting and diarrhœa stopped—three stools daily. The child was quiet, and slept twelve to sixteen hours out of twenty-four. Looked cleaner and brighter.

June 26th. The general condition is the same; bowels regular, tongue clean, complexion more natural.

On July 14th the weight was 8 pounds and 3 ounces, a gain of 1 pound and 10 ounces in two weeks; 26 ounces in fifteen days equals $1\,{}^2/_3$ ounces daily gain. The milk was continued in the same quantities; a fresh supply was furnished at the clinic on every visit. The child was seen two or three times every week.

July 29th. Weight, 8 pounds and 10 ounces. Gained 7 ounces in fifteen days, or $^1/_2$ ounce daily out of the 48 ounces of milk consumed.

August 4th. Had an attack of vomiting and diarrhœa, which was relieved by one dose of castor-oil. There are three or four stools daily.

August 7th. Milk continued as usual. The child looks bright; face smooth and of a natural color. Sleeps well, appetite good.

August 14th. For the last two days there is vomiting following an attack of cough. Child takes her food well; mucous râles on both sides of the chest; temperature, 101° F.; diagnosis of bronchitis. A teaspoonful every three hours of mistura glycyrrhizæ composita, to which some belladonna had been added, relieved the cough.

September 4th. The child has a normal temperature, cough is stopped, general condition is good, digestive organs are in good order.

The child was not seen until September 20th. Weight, 10 pounds and 14 ounces. The child is still taking the milk, and appears to enjoy very good health.

Case II.—Abraham Friedman, 1 year old, was fed at the breast for the first seven weeks of his life. Since then he had been receiving condensed milk. On July 3d was first seen at the German Poliklinik, with the history of diarrhœa, twelve greenish stools a day, vomiting once or twice daily.

On examination, a pale, bloated child; skin flabby, smooth, and dry; fontanelles open, dentition retarded, ribs beaded, abdomen pendulous, limbs weak, and bones very thin. Weight, 17 pounds and 10 ounces.

Diagnosis: Gastro-enteritis, rachitis.

Treatment: An irrigation of colon and rectum with a decinormal saline solution; 5 grains of betanaphthol-bismuth every three hours.

Diet: Gaertner milk, three or four cans daily, at intervals of three hours.

On July 7th the general condition is better, no vomiting, two or three stools a day.

July 14th. The condition remains the same.

July 29th. No diarrhœa, no vomiting; has two stools a day.

August 7th. The child's weight is 20 pounds and 10 ounces.

September 3d. The child receives, in addition to the mother-milk, soup and rice. The general appearance is better; two stools daily of a brownish-yellow color. The child was discharged cured.

Case III.—Abraham Bassick, 7 months old, first seen at the dispensary July 21st. Previous history: Born at term; for the first three days after birth he received the breast, and then he was

fed on condensed milk. The child has an erythema intertrigo and lichen tropicus. Now suffers with diarrhœa, vomiting, and colic. Child is considerably emaciated, and weighs 8 pounds and 14 ounces, including his clothes.

Diagnosis: Athrepsia infantum.

Prognosis doubtful.

Treatment same as in Case I. Feeding: Number of cans daily, three; number of meals per day, six; at night, two.

Clinical results: The child increased in weight; the condition of the gastro-intestinal tract seemed to improve while he was taking this form of food; there was no vomiting nor diarrhœa for the first three days after the commencement of the feeding. The child was infected with measles on August 9th, and was removed from our observation. The child died of pneumonia, August 16th.

Case IV.—Grace Bliss, 2 months old, was first seen August 14th. Mother had a number of miscarriages and lost several children; has had several still-born children, some covered with an eruption. The present child was born at term, weight not known; has been nourished at the breast until to-day. For the past two weeks the child has been restless, cries a good deal; coughs, has coryza; also has eructations and passes a great deal of wind; three or four greenish slimy stools a day.

The examination shows a large, square head, thick epiphyses, distended abdomen, beaded ribs, flabby skin. There are no eruptions, and their existence previously is denied. The temperature is normal; no enlarged glands. Weight to-day, 11 pounds; the child has been losing weight gradually.

Diagnosis: Athrepsia, rachitis, lues congenitalis.

Treatment: The breast-feeding is to be alternated with Gaertner milk, one to one and one-half cans daily.

The child was seen every other day until August 28th. General condition good, takes the milk readily, there is much less colic, the child seems more contented and more quiet; stools are yellowish and appear more normal in consistence.

On September 1st the child's weight was 11 pounds and 11 ounces: a gain of 11 ounces in two weeks. The child has been watched during the month of September, and has received small doses of calomel—$^{1}/_{10}$ grain three times a day for its lues—besides a bichloride bath, 1 to 10,000, every third or fourth night.

We consider this case very much improved.

Case V.—Mary Burghardt, a premature child, born at the eighth month of utero-gestation. Mother reports that it weighed about two pounds (*sic*). It was first seen on the 1st of August. During the first week of life the child appeared fairly well, slept quietly, and took the breast without any signs of discomfort. The child is now eleven days old; we are told that it coughs, moans, and cries when touched. There are frequent soft stools. The child is about one and one-half feet long, and weighs three pounds. The mother states that she has lost several children in their infancy and had several miscarriages.

Examination: The head is of normal shape, with the soft bones and open fontanelles at this age. The face has a senile expression, but the skin is of normal color. There is no eruption; there are no beaded ribs. The upper extremities are very thin, the hands cold, the feet cold. The veins are enlarged; the abdomen is distended, tympanitic on percussion. The mother states that the skin of the lower half of the body came off in large scales a few days after birth. The skin is dry and shrunken. Temperature, 101.6° F.; pulse, 138.

Treatment: Irrigation; calomel, $^1/_{10}$ grain t. i. d. Gaertner milk, 2 ounces every three hours.

The diagnosis of the case was congenital syphilis and athrepsia infantum.

The child was reported considerably improved, but it was thought advisable not to increase the quantity of milk until the 28th of August, when the child received $^1/_2$ ounce more at each feeding. The child was watched during the month of September, and is considerably improved to-day. Weight, 4 pounds and 9 ounces on September 25th.

Owing to the coolness of the limbs, inunctions of oil were given every day following the bath, and the child's body was wrapped in cotton-wool.

Besides the above cases we have had fifteen patients to whom Gaertner milk was given since the beginning of June last. In some cases it was necessary to add sugar to the milk, as many children objected to the taste. In one case (Case III) no deductions can be made, owing to

the child's infection with measles and pneumonia resulting fatally.

Cases I and V serve as splendid illustrations for the proper determination of the value of this food, as both were syphilitic and prematurely-born children. The other two children (Cases II and IV), although much stronger at the commencement of the treatment, improved very rapidly. We sometimes diluted the Gaertner milk with equal parts of barley- or rice- water, and if this latter mixture was not retained, then the Gaertner milk was discontinued. In the above cases the milk was borne very well, and is continued up to the present day. Although our experience is not so large as that of Professor Escherich, we feel that we can indorse both his statements and those of Professor Gaertner.

The assimilation of this form of food, judging from the stools, is equal to that of any other modified milk. The German journals assert that rickets and scurvy can be prevented by using this milk. As our observations have not been carried on long enough, we cannot yet corroborate this.

As we frequently notice that some children show a distinct idiosyncrasy when given milk, so it was in one case in which neither cows' milk, nor modified milk, nor breast-milk, nor Gaertner milk was tolerated. That child fared best on malted milk, properly diluted.

Conclusions.—The small amount of proteid matter contained in the milk appeared to be very easily assimilated in the cases above mentioned. Case I is a splendid illustration of a tolerance of this form of feeding, when neither cows' milk, condensed milk, nor malted milk was retained. We felt greatly encouraged, especially in the very hot July days, to find this baby gaining in

weight, for it must be remembered that this child, in our city with poor hygienic surroundings, gained, from the end of June to the 14th of July, 26 ounces in fifteen days.

Case II, suffering from summer complaint about the same time, early in July, made very rapid progress, and while it could not digest a dilution of one-third milk and two-thirds barley-water without passing six or eight stools a day, fared very well on the Gaertner milk.

Case III was under observation from July 21st until August 9th, and, although progressing favorably, unfortunately contracted measles and died.

Case IV, an emaciated child, had been receiving breast-milk, which did not satisfy it. It frequently nursed from thirty to thirty-five minutes at the breast. The child's mother insisted on nursing it, and thus we gave mixed feeding, alternating the breast-milk with the Gaertner milk. Thus the child has received from two to three cans of milk per day, without showing any evidences of colic, and without having gastric or enteric disturbances. The treatment has been continued for over two months.

Case V, the prematurely-born child with congenital syphilis, was certainly one which was well adapted for the trial of this form of feeding. When she was first seen there were thick, cheesy stools, which, after the gastro-intestinal tract had been cleaned and feeding changed, showed an entire cessation of the colicky symptoms. When commencing this treatment, the child having previously fed on cows' milk, I ordered all milk to be stopped, and fed the child on barley-water and rice-water for three days, after which I gave Gaertner milk, 1 ounce every three hours on the first day, 2 ounces every three hours on the second day, 3 ounces every three hours on the third

day. Considering the syphilitic condition and the fact that it was a premature child, the increase of 3 pounds and 7 ounces from August 11th until September 25th, during a period of six weeks, speaks for itself.

In conclusion I desire to thank Dr. George Saxe and Dr. McConville, Dr. de Hart, and Dr. Emil Joel for kind and valued assistance.

CHEMICAL REPORT, BY HERMAN POOLE, F.C.S.

The chemical examinations were made with the idea of working out some connection between the substances ingested and those excreted. To this end the milk fed was analyzed, and from this the quantity of each constituent fed to the child daily was determined. The fæces were also examined so as to ascertain the quantity of undigested fat and casein voided. The results of both sets of analysis are given below, the fæces examinations being tabulated and plotted for the better elucidation of the facts.

The Milk.—The milk used in feeding the children contained the following: Fat, 3.05 per cent.; casein, 2.09 per cent.; milk-sugar, 6 per cent. Specific gravity, 1.0275. Reaction, faintly alkaline.

When cold, part of the fat separates out, forming a layer on the top of the liquid. On being warmed and thoroughly shaken, this is completely emulsified and distributed through the fluid. Its appearance is that of a good, rich milk; in taste a little sweeter than ordinary cows' milk; and it is more liquid and mobile.

Each can contained $^1/_3$ of a litre, or 20.34 cubic inches, weighing nearly 9 $^1/_2$ ounces. Of this there was: Fat, 0.289 ounce; casein, 0.198 ounce; milk-sugar, 0.569 ounce; total, 1.056 ounces.

Each child consumed from three to four cans of the milk per day, and hence used: 0.867 to 1.156 ounces of fat; 0.594 to 0.792 ounce of casein; 1.707 to 2.276 ounces of milk-sugar.

The milk was perfectly sterilized, a can remaining open for five days without thickening or showing acidity. The can analyzed had a shot of solder in it, which was perfectly bright, showing no chemical action and consequently no solution of lead.

The Fæces.—The chemical examination of the fæces was made with a view of obtaining, as nearly as possible, the percentage of undigested fat and casein. To this end the nurses were instructed to deliver at the laboratory three times a week the napkins used during the previous twenty-four hours. They were put into cigar-boxes and kept in them until examined, which was on the day of receiving them. In some cases they were in very good condition, but many times they were dry and hard, the deposit adhering so firmly to the cloth that it was almost impossible to remove an amount sufficient for analysis and have it free from adherent cotton-fibre. This was especially the case when cotton flannel was used, as was frequently done.

In all cases except No. 1 (Shattuck) the weight of the fæces given is below that actually voided; in case No. 2 as much as 25 per cent. can be added to the amount given; with Nos. 3 and 4 at least 50 per cent., and on some days the amount obtained for analysis was not one-half of that actually voided.

The amount of moisture was, of course, much influenced by that of the liquid excretion, which naturally varied considerably. Still, to avoid necessity of laborious analysis, the hypothesis was adopted that the amount of

moisture absorbed from the fæces by the cloth was equal to that added by the liquid excretion. In some cases I think this was correct; in others it is doubtful, especially when the fæces as voided were very thin and the napkin had evidently been kept long enough to become dry. This was a matter very hard to regulate, and must be accepted as found.

The physical appearance did not vary very much in individual cases, except in times of intestinal disturbance. After a few days the cloths of Case I would have the fæces in a single mass, and of such consistence that over 90 per cent. of it could be easily removed. While the child was suffering from an attack of the diarrhœa, as shown by a rise in the curve, of course such a condition could not be expected. There was a decided improvement in the color in each case, it changing from a dead clayey appearance to a more or less decided yellow, with occasionally a greenish tinge. When dry, as was sometimes the case, the color was uniformly brown or dark brown.

In most cases the fæces at first were very thin and spread all over the cloth, but with those continued for a time this character changed to becoming firmer and more collected in one place. Some of the cases were so poorly taken care of that no mention need be made of the condition, it being hardly possible to obtain a sufficient quantity for satisfactory examination.

With one exception the smell was uniformly very faint and not of an offensive character. The exception is the case of the Bassick child, which was fed with egg-albumin in addition to the milk. One of the other cases showed a faint skatol odor twice, but in none of the others was it noticed, and in this case there was not sufficient skatol to admit of separation. On many days the lactic-

acid odor was not perceptible, although litmus-paper showed a faint acidity.

The reaction was almost uniformly acid, not strong at any time, and not measurable except in very few instances, and in these only to a very small fraction of a per cent. (0.005), as determined with decinormal ammonia solution. On some days no change in moistened test-paper could be observed after fifteen minutes. No decided alkaline reaction was found except once, and this was in a dried sample, the reaction of which may have been influenced by the urine present.

The quantity in the same case did not vary very much. When a very large figure is given there was evidently an accumulation of two days, as was shown by the physical character. As mentioned above, in some cases I was not able to remove more than half of the total, and, of course, the amounts given do not fairly represent the quantity. This is true with all cases except Case I, which will average within 10 per cent. of the total voided. It is impossible to impress the kind of people from whom these were obtained with any idea of care in this regard, and the cloths brought to me show it.

Remarks analogous to those made regarding the amount of excretion apply as well to the water contained. Still, a fair average can be found and will probably be near the correct one. In most cases I was obliged to put all together, wet and dry, to have sufficient for analysis, and this at times caused an abnormal number to appear as the water-content. This is notably the case with the Bassick child, in which the water-content dropped on one day to 20 per cent., the cloths being practically dry. It was also noticed, in regard to this one, that in this instance the ordinary strong smell was absent.

In each case the quantity of fat and casein decreased after the milk was used, and remained at a lower percentage. This does not apply to the Bassick case; and, in fact, this case was amenable to no law but that of uniform filth. Whenever a temporary sickness occurred the percentages would rise, and with the Shattuck child this rise also occurred nearly simultaneously with her being taken to Staten Island, where, although she was reported in good health, the percentages kept higher than when she was in the city, and on her return to the city they fell again. Still, in none of these cases of rise in percentage did it reach that point which was attained at the beginning of the experiments. No notice is taken, in these results, of the quantity of fat which exists in the fæces combined with calcium, iron, alumina, etc., as insoluble soaps. These have undergone some change in the system, and only the undigested or unchanged fats which were soluble in ether were determined.

The methods used for determining the fat and casein were those mentioned in my paper read before the American Chemical Society at Detroit in 1897. The fæces were dried at 90° F., then at 110° C., and the ether extract taken. This ether extract, containing also cholesterin with fat, was saponified with alcoholic potassa and the cholesterin taken up with ether. The fat-acid soap was then decomposed by hydrochloric acid and the fat determined. The residue from the ether extraction was then treated with water and with alcohol. This residue, containing undigested casein and epithelial cells from the intestinal tract, was digested with diluted hydrochloric acid for ten to twelve hours, and this solution used to determine the nitrogen by the Kjeldahl method. Casein was considered as being 15 per cent. nitrogen.

Of course, these methods may be open to objections, but I know of no better ones, and after trying several others decided that they would suit the investigation and its requirements the best, and I actually believe that the true state of affairs has been shown better than it would have been by any of the methods previously used.

The following tables show the results of the examination, giving the date of receiving the fæces, the general appearance, consistence, reaction, quantity in grammes that could be removed from the cloth, and the percentages of water, fat, and casein obtained by the methods given above. The percentages of cholesterin are not given, although they were, of course, obtained. They did not run in a uniform proportion to the fat, being at times very much larger than at others. (See pages 230 to 232.)

Discussion of the Curves.—The curves are made by using the days of the month as abscissas and the percentages as ordinates. The zero-point at the intersection of the axes is then the date of the commencement of the experiment on the line of the abscissas and 0 per cent. on the line of the ordinates. (See page 233.)

The Shattuck curves: The curve of the casein percentage runs very even until the latter part of July, the time when the child was taken out into the country. While she was there her health was reported good, except at the middle of August, when she had an attack of diarrhœa, which lasted some time. This is plainly shown on the curve, both casein- and fat- lines responding to the conditions. Why the curves rose about July 29th is not explained. The fat-curve made a decided downward movement from the beginning, and, except for the fluctuations due to intestinal troubles, remained low; in all cases it remained lower than it was at its inception. This

curve, like that of the casein, tends upward about July 29th, and does not return to its former low figures.

The Friedman curves: With these curves, as with the Shattuck ones, the effect of the feeding is shown by a downward movement. The two lines run closer together than in the Shattuck case, and both respond to the diarrhœa which commenced August 1st and was at its height at about the 17th. The fat-curve seemed to respond more quickly to changes in the intestinal tract than did that of the casein, and at times no change in the casein could be determined when a marked one in the fat was evident. At other times, however, from some cause, the casein showed a change not to be noticed in the fat.

The curves of the other cases are not plotted, as they were soon discontinued, and the data obtained were not considered sufficient.

At the time I experimented with this mother-milk it was sold and delivered in tin cans. At that time I distinctly told the manufacturer that milk must be fresh and must be delivered daily in bottles. Milk of this description, in which the proteids are mechanically reduced, forms an ideal food, and no doubt some future manufacturer will reap the benefit of milk prepared in this manner and freshly sold in carefully-sterilized bottles. Thus, we can account for the success attained by Professor Escherich as well as by Professor Gaertner and others, as theirs is a milk prepared daily, and delivered in bottles. Some interesting editorials in various medical journals followed the publication of my article on Gaertner mother-milk. To those who are interested I should advise reading an editorial in *Pediatrics,* January 15, 1898, and also an editorial in the *Atlantic Medical Weekly,* January 15, 1898. An editorial in the *Woman's Medical Journal,* January,

CASE I. DOROTHY SHATTUCK.

DATE (1897).	APPEARANCE.	CONSISTENCE, ETC.	REACTION.	QUANTITY, GRAMMES.	WATER, PER CENT.	FAT, PER CENT	CASEIN, PER CENT.
June 28th	Clayey	Thin	Acid	28.00	67.70	5.66	1.06
June 30th	Clayey	Soft	Acid	23.00	75.00	4.72	1.06
July 3d	Yellowish	Soft	Acid	26.00	73.30	3.80	1.16
July 6th	Slight yellowish	Soft	Acid	30.00	76.10	2.25	1.20
July 8th	Yellowish	Lumpy	Faint acid	29.00	68.80	2.25	1.12
July 10th	Yellow	Lumps	Nearly neutral	10.80	69.90	3.80	1.06
July 12th	Yellow	Lumps	Neutral	35.70	65.00	3.24	1.08
July 14th	Yellow	Lumps	Neutral	38.60	65.00	2.99	1.09
July 16th	Yellow	Lump part quite dry	Faint acid	62.50	55.00	3.49	1.29
July 18th	Yellow	Lumps	Faint acid	42.60	71.50	2.46	1.05
July 20th	Yellow brown	Lumps	Faint acid	15.80	63.20	2.50	1.12
July 23d	Three yellow, one brown	Three soft, one dry	Very faint acid	51.80	51.20	2.23	0.70
July 30th	Yellowish	Lumpy	Neutral	33.00	61.20	2.50	1.85
August 6th	Yellow green	Soft	Acid	21.00	75.00	2.92	1.50
August 13th	Yellow	Soft	Neutral	18.40	70.60	3.99	3.00
August 23d	Yellow green and dark	Mixed	Neutral	12.70	69.00	3.66	2.90
August 27th	Yellow	Soft	Very faint acid	29.00	69.26	3.40	2.45
August 29th	Yellow green	Soft	Very faint acid	23.40	63.00	3.65	1.92
			Average	27.96	67.20	3.25	1.48

CASE II. ABRAHAM FRIEDMAN.

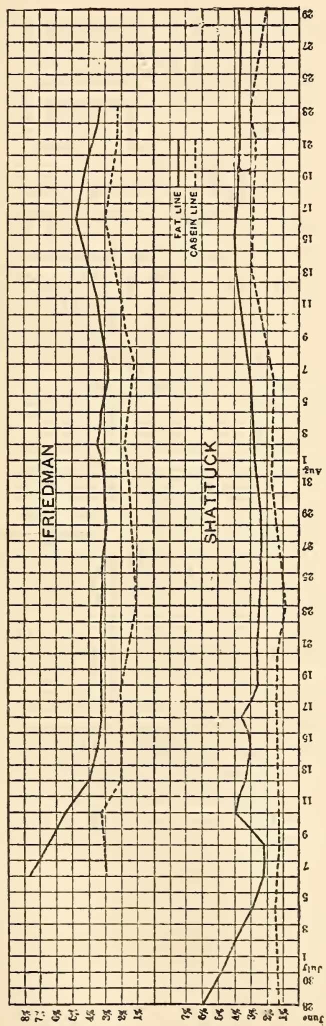
Date (1897).	Appearance.	Consistence, etc.	Reaction.	Quantity, Grammes.	Water, Per Cent.	Fat, Per Cent.	Casein, Per Cent.
July 6th	Clayey	Thin	Acid	9.80	77.95	7.66	2.92
July 10th	Smeary, yellowish	Thin	Faint acid	5.20	60.00	5.18	3.06
July 12th	Yellow brown	Thin	Faint acid	7.70	72.83	4.01	2.05
July 18th	Yellow brown	Soft, strong smell	Faint acid	33.44	65.14	3.09	2.03
July 23d	Two yellow, one brown	Soft	Faint acid	19.36	70.20	3.15	1.08
July 28th	Yellow brown	Soft	Neutral	6.60	65.66	3.00	1.54
August 2d	Yellowish	Soft	Acid	12.60	69.18	3.29	1.86
August 6th	Yellow green and brown	Soft	Faint acid	8.76	74.89	2.83	1.25
August 9th	Clay yellow	Soft, strong smell	Acid	10.56	75.18	3.25	1.79
August 11th	Yellowish	Thin	Faint acid	9.32	76.24	3.43	2.03
August 16th	Yellow green	Very thin	Faint acid	3.12	79.69	4.49	
August 23d	Brown	Pasty	Faint acid	17.13	71.84	3.43	2.42
			Average	11.92	71.57	3.83	1.64

Case III. Abraham Bassick.

Date (1897).	Appearance.	Consistence, etc.	Reaction.	Quantity, Grammes.	Water, Per Cent.	Fat, Per Cent.	Casein, Per Cent.
July 20th.	Too small quantity for examination						
July 23d	Yellow brown	Soft, strong smell	Acid	4.83	78.40	4.28	3.54
July 28th.	Brown	Dried	No reaction	5.40	20.53	4.70	4.50
July 30th.	Yellow and brown.	Thin	Faint acid	5.30	75.45	3.48	3.00
August 2d	Yellow and brown.	Slimy, strong smell	Faint acid	7.50	55.50	4.00	2.53
August 6th	All dark, but one yellowish	Hard, but one thin and strong smell.	Faint acid	6.33	55.78	4.23	2.79
			Average	5.87	57.13	4.14	3.27

Case IV. Grace Bliss.

Date (1897).	Appearance.	Consistence, etc.	Reaction.	Quantity, Grammes.	Water, Per Cent.	Fat, Per Cent.	Casein, Per Cent.
August 18th.	Yellow	Soft, dried	Very faint acid	3.75	53.25	21.06	4.02
August 23d.	Yellow green	Firm	Very faint acid	3.95	46.55	22.45	4.07
August 27th.	Yellow	Dried lumps	Very faint acid	4.25	55.00	18.36	3.63


FRIEDMAN
SHATTUCK
FAT LINE
CASEIN LINE

1898, published in Toledo, Ohio, is worth repeating. Here is the article as published:—

"There has been no greater advance in preventive measures than in the realm of infant-feeding. Where substitution of pabulum other than mothers' milk is necessary, we have for ages been at our wits' end for a desirable food.

"In our research we have tried all sorts of grains and foods —and cows' milk has been incorporated in them, with small success. We all are only too familiar with the poor results that accrue from cows' milk, and the sequelæ that present themselves after a diet of this substance. But finally practical measures are instituted and tangible results ensue.

"We are all more or less familiar with the proper method of preparing milk, but we are sorry to say that the average mother is appalled at the machinery which is essential to the proper preparation of baby's food.

"In the larger cities this may be secured correctly prepared, but in the country and village the lack of proper machinery is an insurmountable obstacle that confronts us.

"It must be admitted that much has been done, and sterilizers that are simple produced; but to prepare milk according to the latest chemical research is beyond the paraphernalia of the average practitioner.

"What we need is a simple, handy method of eliminating the casein from cows' milk, and the man or woman who produces it will be a benefactor to the race.

"Louis Fischer, Professor of Diseases of Children in the New York School of Clinical Medicine, has made some very satisfactory and encouraging tests with milk prepared by Gaertner's method, and the results are good; so there is no doubt about the value of Gaertner's method; but how is the doctor in the country to prepare such a milk?

"The milk used by Dr. Fischer was as follows:—

"Fat, 3.05 per cent.; casein, 2.09 per cent.; milk-sugar, 6 per cent. Specific gravity, 1.0275. Reaction, faintly alkaline.

"When cold, part of the fat separates out, forming a layer on the top of the liquid. On being warmed and thoroughly shaken, this is completely emulsified and distributed through the fluid.

Its appearance is that of a good, rich milk; it tastes a little sweeter than ordinary cows' milk; and it is more liquid and mobile.

"Each can contained $^1/_3$ of a litre, or 20.34 cubic inches, weighing nearly $9\,^1/_2$ ounces. Of this, there was: Fat, 0.289 ounce; casein, 0.198 ounce; milk-sugar, 0.569 ounce. Total, 1.056 ounces."

Backhaus's Milk.[53]

The following method is employed in the production of this food. The milk from different breeds of cows is mixed and passed through a centrifuge, to separate the cream from the milk and to remove any impurities that might have gained access to the milk, notwithstanding the great care used in handling. Three grades are produced: two for infants, the third representing full milk in its composition. After separating it from the cream the milk is exposed to the action of a mixture of rennet, trypsin, and sodium carbonate, which are combined in such proportions that the trypsin will have converted at the end of thirty minutes 30 per cent. of the casein into soluble albumin. By this time the action of the rennet coagulates the balance of the casein and thus arrests the action of the trypsin. The temperature of the mixture is now raised to 80° C. (176° F.) by the introduction of steam into it. At this temperature it is kept for five minutes. At the end of this time it is strained through cloths and mixed with half its volume of water, one-fourth its volume of cream, and the necessary amount of sugar of milk. It is finally put up in bottles holding 125 grammes (about 4 ounces) and sterilized.

The second grade, for older children, is obtained by mixing equal parts of milk and water with half the quan-

[53] Archiv für Kinderheilkunde, B. 26, H. 5 and 6.

tity of cream and with milk-sugar. This is put up in quantities of 200 grammes (about 6 $^1/_2$ ounces).

The third grade, in bottles holding 300 grammes (about 10 ounces), represents cows' milk in composition, modified by the above-mentioned process. The composition of the three grades is given as follows:—

Fat	3.1	3.2	3.3
Sugar of milk	6.0	5.4	4.8
Casein	0.6	1.8	3.0
Albumin	1.0	0.3	0.5
Ash	0.4	0.4	0.7

The milk has been tried at the Wiener allgemeine Poliklinik by Frühwald in a series of twenty cases, the histories of which are given by the author. With the exception of six, these children have been under observation for more than two months. When first seen the children were all suffering from different forms of digestive disturbances, and from malnutrition; some were suffering from severe marasmus, and most of them passed through some other disease while they were under observation. Three of the infants took the breast in addition to the Backhaus milk for periods of two and three weeks, when they, too, had to be put on the artificial milk entirely. The children took about six bottles of No. 1 up to four weeks, seven to eight to the end of the second month. From the middle of the third month the second degree was gradually substituted, while No. 3 was used only in the case of an older child. A daily gain was observed of from 18 to 30 grammes (about $^1/_2$ to 1 ounce). In private practice and in healthy children a gain of 50 grammes (about 1 $^1/_2$ ounces) not rarely happens. The milk keeps well.

Lahmann's Vegetable-milk.

In Europe, and recently also in our country, the feeding of infants has been enriched with a new product; thus, Dr. Lahmann believes that the great panacea is feeding infants with milk which he designates as "vegetable-milk." It resembles a thick jelly, and is made by Hewwel & Veithen, Cologne. His theory consists, in brief, in substituting nuts and almonds, which are rich in albumin and fat, instead of cereals to dilute milk, his idea being that an emulsion, which is digestible and supposed to be rich in albumin, is doubtless better than pure water or a thin starch-paste. In order to add food-salts, which are not supplied by this means, he extracted them from leaf vegetables, which are rich in food-salts, and added some sugar-syrup. In this manner he believes to have made a preparation which he states is, chemically, equal to human milk, and full of nutritive value. His idea is that the interposition of plant-albumin (conglutin) particles, which coagulate with difficulty between the coagulating casein masses, would increase their digestibility by breaking them up, and that the digestion of the plant-albumin and oil, as well as of the sugar and food-salts, would present no difficulty.

Stutzer, of the University of Bonn, reports thus: The vegetable milk is distinguished from children's food by the absence of starchy substances. In common with Biedert's cream-mixture, the vegetable-milk contains considerable quantities of fat in an emulsified condition. It differs from the cream-mixture in the way it is prepared, and in its other qualities.

Chemical Analysis.

Fat	34.72 per cent.
Plant-casein and similar nitrogenous constituents	12.00 per cent.
Sugar and plant-dextrin	31.02 per cent.
Salts	1.64 per cent.
Water	20.62 per cent.

My own personal experience has been rather favorable with the use of the vegetable-milk, inasmuch as an emulsion of almonds and nuts was used to dilute the curd of cows' milk. Thus, equal parts of vegetable-milk with cows' milk were taken by an infant for several months, and it was very well assimilated. Not only did the child gain in weight, but the bowels were in a fair condition, and the infant remained strong. My experience, however, is too limited as yet to give a positive opinion.

Condensed Milk or Condensed Cream.

Hundreds of infants are fed with condensed milk. This has its reason:—

First: The readiness with which condensed milk is obtained.

Second: The great cheapness of this article.

Third: The ease with which the feeding-mixture can be prepared.

Jacobi says that some manufacturers use pure cows' milk; others find it in accordance with the health of their bank-accounts to use skimmed milk.

Quantity of Sugar in Condensed Milk.—Milk sold in our city for immediate use contains about 12 to 15 per cent. of sugar. Milk to be kept for an indefinite length contains as much as 50 per cent. of sugar. These variations show how serious it is to *use the same quantity* of con-

densed milk *all the time* and from different sources with such an *enormous variation in the quantity* of sugar.

Kehrer—quoted by Jacobi—states, regarding it, that it increases the formation of lactic acid. Fleischman states that it gives rise to thrush and diarrhœa; Daly, that it fattens them (?), but gives rise to rachitis.

The worst specimens of rachitis and spinal rickets are seen in my clinic in condensed-milk babies. And still in discussing my paper on infant-feeding (read by invitation before the Society for Medical Progress, April 11, 1896), and which was published *in extenso* in *Pediatrics* for July 15, 1896, we find Dessau, with a large infants' experience, still advocating the *constant use* of condensed milk as an infant-food.

In traveling, when good fresh cows' milk cannot be obtained, then I permit the use of condensed milk, but for a few days or for a week only, as on the ocean steamer, where cows' milk cannot be had.

My experience among hundreds of children seen in my Children's Service at the German Poliklinik and also at the service at the West-Side German Dispensary during these last ten years has been that children so fed have rickets; that they are predisposed to the infectious disorders; that they have less resistance and far less vitality, especially in combating such diseases as pneumonia or diphtheria; that they have tendencies to hernias and deformities, owing to the softer condition of their muscles and bones; that they invariably suffer with constipation, alternating with diarrhœa; that their dentition is delayed, compared with other methods of hand-feeding. Thus summing it up, I cannot approve of this method at all.

So condensed cream will be lauded by the mother whose baby is well, and again the same food will be con-

demned by the mother of an infant whose rickety head, bones, and muscles are founded on an impoverished diet of condensed milk. We can account for the rickety child, but we cannot account for the healthy one on the same food.

Buttermilk.

Ballot recommends buttermilk as an infant-food. He cooks a tablespoonful with a tablespoonful of wheat-flour for a few minutes and adds 15 grains of sugar to the same.

In cases of diarrhœa he substitutes rice-flour instead of wheat.

Buttermilk is composed of:—

Water	90.62
Fat	1.25
Milk-sugar	3.38
Nitrogenous substances	3.78
Lactic acid	0.32
Salts	0.50

Buttermilk contains lactic acid. If allowed to rise spontaneously so that it can be "skimmed" off, we have, even in low temperatures, several acids formed, believed to be lactic acid and fatty acids.

When milk is skimmed it has a specific gravity of 1.035 to 1.037 and contains:—

Water	90.63
Nitrogenous substances	3.06
Fat	0.97
Milk-sugar	4.77
Salts	0.75

The author has seen decided benefit from skimmed milk, and from the above chemical composition it can be readily seen that it contains some nutritive properties.

It is naturally unsuited to the requirements of an infant; in fact, it is, as Jacobi puts it, very decidedly "objectionable."

It is more adapted for a child after the period of weaning.

Cocoa.

Dr. H. Cohn,[54] in describing the chemical value of cocoa as nourishment, states his belief that it is overrated, and denies the value of the same. He bases his statement in the poor method of assimilation, owing to the large quantity of fat contained therein, which could be removed by chemical process. Cocoa also contains 5.5 per cent. of tannic acid. Besides, the albuminoids are converted, by the process of roasting, into a very indigestible product. About the tannic acid, he says that it precipitates the digestive ferments, and unites with the albuminoids into insoluble compounds, causing the constipating factor. According to his experiments, only one-half of the 16.6 per cent. of the albuminoids are absorbed, and, in order to give the human body enough cocoa to have a sufficient quantity of proteids, it would be necessary to feed at least somewhat over 2 pounds daily, provided cocoa alone was given for nourishment.

[54] Zeitschrift für physiologische Chemie, xx, 1, 2.

CHAPTER XXXI.

The Feeding of Diphtheria-Intubation Cases.

When an infant has a foreign body—the intubation-tube—in its throat, swallowing is more difficult, because the epiglottis cannot entirely close. Frequently, while swallowing there is coughing, gagging, and regurgitation, caused by fluids (food) trickling into the trachea. In this manner, it is claimed, Schluck-pneumonia has frequently been caused. If the child's head is turned to one side—either side—and swallowing is provoked in this manner, then we can sometimes avoid this trickling into the trachea; or another method is to lay the child flat on its back and allow the head to hang lower than its body, and feed it slowly with a spoon. This is really known as the Casselberry method of diphtheritic feeding.

If this method is not satisfactory, and if we find that we cannot get enough food into our patient, then we can resort to rectal feeding.

RECTAL FEEDING IN DIPHTHERIA.

Bear in mind that the rectum absorbs, and does not digest. Hence, all food must be peptonized. The method is very simple. First: Always cleanse the rectum. This is done by washing the rectum with an enema of a pint of soap-water made by dissolving ordinary Castile soap or glycerin soap in warm water. The temperature of the soap-water to be 100° to 110° F. Quantity, from 1 to 2 pints. After the rectum is cleaned, and the fæcal movements all passed, it is advisable to wait about five minutes

to give the rectum a chance to rest. Then we proceed to inject the rectum with a suitable quantity of peptonized egg. Small quantities are better borne than large quantities; hence, no more than 1 to 2 ounces should be thrown in at one time.

The following formula will give an idea of the way in which food is to be prepared for rectal injection:—

Take 2 teaspoonfuls of ordinary starch and rub the same up with an ounce of lukewarm water. This makes a very milky mixture. To this mixture we add the yolk of 1 egg, and one-half of an ordinary Fairchild peptonizing tube. This is to be slowly, but forcibly, injected into the rectum. Various methods of injecting can be used, the simplest being with the aid of a bulb rectal syringe, known as the infant's rectal syringe. (See Fig. 50.)

Another method consists in pouring this emulsion of starch-water and peptonized egg into a funnel ending in a rectal tube, a so-called rectal feeding-tube made by Tiemann, of New York City. (See Fig. 52.)

The secret of success is undoubtedly the amount of food brought into a child's body during its illness, and, the more food absorbed, the greater resistance will the child have. It is advisable not to overtax the rectum; hence, my method of feeding is to use the peptonized yolk of egg with starch-water as mentioned above, and follow it—three hours later—by substituting an ounce of peptonized milk instead of the yolk of egg.

With this ounce of milk an ounce of starch-water should be combined. If there is looseness of the bowels, and the food will not remain in the rectum, then 1 or 2 drops of the ordinary tincture of opium added to each enema will soon quiet the irritation of the rectum, and thus aid in retaining the nutrient enema.

CHAPTER XXXII.

Forced Feeding.

This is commonly known as gavage. This consists in forcing a small feeding-tube, a No. 7 rubber catheter, through the mouth and pushing it forcibly toward the pharynx and directly into the stomach. This feeding-tube consists of a black hard-rubber or glass funnel to which is attached a piece of rubber tubing about ten inches long; then a small glass tube (a connecting tube) over which is drawn the rubber No. 7 catheter. In case of emergency, nothing is handier as a connector than the glass portion of the ordinary medicine-dropper, the smaller end will serve to connect with the rubber catheter mentioned above, and over the larger portion of the medicine-dropper we draw the rubber tubing connected with the funnel. This little apparatus has been very neatly combined for the author's use by Messrs. George Tiemann & Co. (See Fig. 52.)

Having pushed this small catheter into the stomach, we pour the food, usually several ounces of peptonized milk, or dextrinized barley and milk, or albumin-water, or the white of a raw egg mixed with half of a teacup of coffee and milk, or, if desired, a good concentrated soup, or bouillon, or broth, can be used. The same interval governing ordinary meals should be more strictly adhered to while this process of feeding is used. It is self-understood that all instruments, utensils, and food must be strictly clean and sterile.

Place the child flat on its back, and, first, pin either a heavy blanket or a stout sheet securely behind the body

so that the hands are pinned down; have the assistant hold the child's elbows securely on each side; then force the mouth open and quickly pass the catheter, pour the food into the funnel, and when the funnel is empty withdraw the catheter as quickly as possible. If this forced feeding is done very slowly or clumsily, then nausea and sometimes vomiting will be produced thereby. Hence, the technique should be carried out as completely as possible.

NASAL FEEDING.

In some instances it is easier to pass a soft, flexible catheter through the right or left nostril into the œsophagus, and forcibly push the same into the stomach. This is a very simple process, and I have never yet been able to pass the tube into the larynx while gliding it toward the œsophagus. All food should be given warm—preferably between 98° and 100° F. Small quantities of milk, strained gruel, broth, or albumin-water will be far better digested than heavier food. In some instances, where milk is not well borne, the ordinary unsweetened cream, in the proportion of 1 teaspoonful of cream to 3 ounces of water, will serve quite well. In other cases I have used very successfully several teaspoonfuls of Mellin's food diluted with an ounce of raw milk, to which 1 ounce of boiling water was added. This latter mixture is highly nutritious, and scalds the milk, and does not require either pasteurization or sterilization. Meat-juice and expressed steak-juice or roast-beef juice should not be forgotten.

Ice-cream and water-ices, very grateful to the feverish patient, contain some nourishment, and should be given in moderation.

HAND-FEEDING.

If children are old enough and can be fed with a spoon, then I invariably prefer semisolid food, such as rice and milk, oatmeal and milk, farina and milk, zwieback soaked in milk, cornstarch pudding, tapioca pudding, or some custard. Thus, my readers must bear in mind, at the risk of repeating, that we cannot make laws governing all, but must seek to individualize, and then, following the outlines and suggestions given above, adapt the same to the requirements of each case.

CHAPTER XXXIII.

Modified Milk.

In an article published by the author in *Pediatrics*, July 15, 1896, the following appears:—

"It is now several years since a Walker-Gordon Milk-laboratory was established in New York. The feeding of infants is based on mixing the ingredients in such combination that, when combined, they should resemble certain chemical formulæ of breast-milk at various ages.

"Blanks are given the physician, which are filled out according to the child's age and weight, calling for a definite percentage of fat, milk-sugar, proteids, water; and prescribing of feedings, the amount of each feeding, the percentage of alkalinity, and the length of time in which the mixture is to be sterilized or pasteurized. This would be a practical method, and appeals to the physician at first, but it is necessary to familiarize one's self with the mysteries of this method before one can properly judge of its merits. I have given modified milk a careful trial in my private practice; it is too expensive for either dispensary or hospital cases."

One of the first symptoms encountered was constipation, which could not be relieved; in five children fed exclusively on modified milk, the constipation was so severe that the formula was changed many times: we added more cream, and still more cream, until we finally abandoned the feeding by this method.

The following case will illustrate what has been said:

N. R., a healthy female, was put, soon after birth, on modified milk.

October 14th: Fat, 2.0; milk-sugar, 5.0; albuminoids, 0.75; lime-water, $^1/_{16}$. Eight feedings; 2 ounces in each.

October 17th: Constipation. Fat, 2.5; milk-sugar, 6.0; albumin, 1.0; lime-water, $^1/_{16}$. Nine feedings; 2 $^1/_2$ ounces in each.

October 27th: Fat, 3.0; milk-sugar, 6.0; albuminoids, 1.0; lime-water, $^1/_{16}$; barley-jelly, $^1/_{15}$. Ten feedings; 3 ounces in each.

November 5th: Fat, 3.5; milk-sugar, 6.0; albuminoids, 1.0; lime-water, $^1/_{16}$; barley-jelly, $^1/_{15}$. Ten feedings; 3 ounces in each.

November 17th: Fat, 4.0; milk-sugar, 6.0; albuminoids, 1.5; lime-water, $^1/_{20}$; no barley. Ten feedings; 3 ounces in each.

November 19th: Curded stools, dyspeptic diarrhœa. Fat, 4.0; milk-sugar, 6.5; albuminoids, 1.0; lime-water, $^1/_{20}$. Ten feedings; 3 ounces in each.

The child did not increase in weight, had a rectal temperature of 100°, slightly-furred tongue, vomited curds, had greenish stools containing undigested particles of fat and true casein and large masses of mucus. The diagnosis of dyspepsia infantum was made; hand-feeding was stopped, the child's alimentary tract was cleaned by giving cascara sagrada, and a proper wet-nurse was secured. The infant at this time was about 6 weeks old. The child nursed very well, and after a few days the stools were normal, both in consistency and color. The infant gained steadily from 4 to 6 and sometimes 8 ounces per week, until she was 7 months old, when suddenly the weight remained stationary. The child was bright and cheerful, but I deemed it necessary to have the milk of the wet-nurse examined by a competent chemist; a specimen of the same was secured in the usual manner described by me in a previous section on "Method of Obtaining Breast-milk for Chemical Examinations." This specimen was examined for the author by John S. Adriance, the chemist of the Nursery and Child's Hospital, who reported the following:—

Fat	2.000 per cent.
Sugar	7.431 per cent.
Proteids	0.882 per cent.
Ash	0.162 per cent.
Total solids	10.475 per cent.
Water	89.525 per cent.
Specific gravity at 70° F.	1.0316

Reaction alkaline.

In the chemical result above given it is very evident that a deficiency in the proteids exists; hence it accounted, not only for the stationary weight, but for the late dentition. The child did not gain an ounce in one month. We discharged the wet-nurse. The following food was ordered:—

Milk	3 ounces.
Cream	2 teaspoonfuls.
Oatmeal-jelly	3 ounces.
Lime-water	1 drachm.
Milk-sugar	1 teaspoonful.
Salt	1 pinch.

Sterilize the above and feed every three hours, the above quantity being for one feeding.

After the infant had taken this food for 6 days it was cheerful, had had one and two yellow stools daily, and gained 6 ounces in 6 days.

The above case will illustrate:—

1. That the child was decidedly dyspeptic while taking its modified milk for about 6 weeks.

2. That for about 6 months the infant thrived very well on the milk of a wet-nurse.

3. That the stationary weight of the infant and the chemical examination of the milk of the wet-nurse showed deficient proteids, which accounted for this non-increase in weight and the lateness in dentition.

4. That a proper milk-mixture, which agreed very well, suited the requirement of this infant, and emphasizes the fact that we must individualize in each and every case.

It is impossible to make an emulsion like milk from its component parts by a synthetic process. Let it therefore be distinctly understood that, once a milk-emulsion is broken up, as is done in centrifuging milk and removing the cream, mixing the whole will never restore the uniformity of the emulsion that existed prior to this division.

Time and again have I examined a drop of milk under the microscope and found an unevenly-divided emulsion

of modified milk, resembling colostrum-milk. The macroscopical examination of modified milk will always show a large amount of butter-fat swimming on top of each bottle of milk when it is cool. If this fat is part of the formula prescribed, then the modified milk does not contain its original amount of fat, and much more must be prescribed, to allow for the separation of the same. Hence it would seem that the percentage portion of the food must necessarily be incorrect.

I am in accord with Jacobi,[55] who says, speaking of laboratory-fed babies:—

"Only one observation struck me in many cases: the formation of the muscles and particularly of the bones appeared to be slow. The teeth came a number of weeks or even months too late; the cranial bones turned slightly soft in not a few instances; in many such cases I had to add animal broths or juice before the usual time. In two, when I tried phosphorus (elixir phosphori), it was rejected; in all others it was well borne and useful."

Jacobi further states, in speaking of the difference between Walker-Gordon and Gaertner mother-milk, that the latter is patented, the former is not. It is a well-known fact that Walker-Gordon milk is patented.

Dr. A. Worcester,[56] speaking of the modified-milk question, calls attention to the lately-patented Walker-Gordon process; so also has Dr. Baner,[57] of New York, and many others. In the *Indian Lancet*, editorially, May 1, 1898, we read the following: "We confess that we

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[55] "Therapeutics of Infancy and Childhood," page 38, second edition.

[56] Boston Medical and Surgical Journal, September 19, 1895.

[57] New York Medical Journal.

cannot agree with the writer of a paper, Dr. D. J. Evans, of the Montreal Foundling Hospital, in what appears to us to be his wholesale distrust of the provision made by Nature for the needs of infancy. We cannot but think that his process errs by overelaboration of those simpler measures by which, with some judicious help in times of difficulty, she has, on the whole, very successfully reared the race of man through countless generations."

In a paper published by Rotch[58] we find the following:

"I would plead in the name of common humanity, as well as in that of the intelligence and scientific reputation of our profession, that this representative body of American physicians should, in its endeavor to advance the general subject of infant-feeding, record itself as opposed to the use of patent or proprietary food of every description."

Further on, in the same paper, the writer states:—

"We should, in fact, remember that the nutriment which we are endeavoring to copy, far from being a cheap product, is, on the contrary, a very expensive one." I leave it to my readers to judge of the sincerity of the writer.

Dr. Louis Starr[59] gives a critical review of his clinical study with laboratory-milk for the last few years. He states:—

"With all the above advantages, laboratory-milk is theoretically the most perfect substitute for normal human milk that science has yet devised. But unfortunately clinical experience, in my own practice at least, does not bear this theory out.

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[58] Boston Medical and Surgical Journal, November 23, 1893.
[59] Archives of Pediatrics, January, 1900.

"The following is a generalization of the results of over two years' study of the use of laboratory milk-food in substitute feeding:—

"These results may be classified under three heads, viz.:—

"(*a*) The satisfactory,—embracing the very exceptional cases of perfectly-healthy children who have been continuously fed upon laboratory-milk, from, or shortly after, birth up to the time of beginning a mixed diet. I have seen but three of these in as many years.

"(*b*) The partially satisfactory, — including cases, much greater in number than the preceding class, in which laboratory-milk was used for a considerable period —six months to a year—without producing active illness, but gradually inducing health conditions necessitating a change of food. Of this class I have seen sixteen cases.

"(*c*) The unsatisfactory. The instances of this group are by far the most numerous, and in it, in my experience, may be placed the vast majority of infants fed upon laboratory-milk after the first eight weeks of life. It embraces those cases in which laboratory-milk feeding must, of necessity, be discontinued on account of the onset of some acute disorder of undoubted dietetic origin. My cases in this class number thirty-five.

"The unhealthy conditions referred to in the second class present a very uniform group of symptoms, viz.: pallid, dry skin; dry, lustreless hair; flabby, soft muscles; indifferent appetite; inactive—not decidedly constipated —bowels, with clay-colored evacuations; light-colored urine; listlessness and disinclination to play; peevishness and restless sleep—in a word, the features of malnutrition. With the muscle-flabbiness there is not always emaciation, but the two conditions are often associated and the little

sufferer is both weak and puny, and the observant mother states: 'I do not know what is the matter with my child; he is not ill, but he does not seem to thrive and is not like other healthy babies.'

"*Illustrative Case.* — Boy, aged 10 months, presented above symptoms; no history of acute illness. Fed from birth upon laboratory-milk, modified in composition as age advanced, until the following strength was reached:—

Fat	4.00	No. of feedings	5.
Sugar	6.00	Quantity	8 ounces.
Albuminoids	2.50	Alkalinity	5 per cent.
		Heat	167° F.

"Improvement began soon and continued steadily under a domestic mixture of:—

		Calculated Percentage.	
Cream, 16 per cent.	1 tablespoonful.	Fat	3.75
Milk	11 tablespoonfuls.	Proteids	2.97
Milk-sugar	1 teaspoonful.	Sugar	4.94
Water	4 tablespoonfuls.		

"For each feeding, every three hours, five meals daily.

"The acute disorders occurring in the third class are:

"*First.—Acute gastro-intestinal catarrh,* indicated by pyrexia, vomiting, and diarrhœa with the expulsion of curds and greenish mucus or large quantities of greenish serum.

"*Illustrative Case.*—Girl, aged 2 1/2 months when seen in consultation. She had been fed from birth on laboratory-milk:—

First and Second Weeks.

Fat	2.00	Alkalinity	5 per cent.
Sugar	5.00	Heat	167° F.
Albuminoids	0.75		

"Bowels occasionally disturbed, stools curdled and greenish. No gain in weight.

Third to Sixth Week.

Fat	4.00	Alkalinity	5 per cent.
Sugar	6.00	Heat	167° F.
Albuminoids	1.00		

"Bowel movements never quite normal, always too frequent and greenish, and often very green, with isolated hard curds and a quantity of mucus; infant restless, sleeps badly, colicky, and gaining weight very slowly.

Sixth to Eighth Week.

Fat	4.00	Alkalinity	5 per cent.
Sugar	6.00	Heat	167° F.
Albuminoids	0.75		

"No change in intestinal symptoms; no gain in weight; infant growing feeble.

Ninth Week.

"Same food, predigested six minutes with Fairchild's peptogenic milk-powder.

"No improvement, except that curds passed are smaller and softer. (Predigestion performed at laboratory?)

"In the tenth week the infant suddenly became very ill; high fever; vomiting; frequent, large, green, watery evacuations, with mucus and curds; rapid and extreme prostration. Milk-food was stopped for twenty-four hours. Fed on barley-water and raw beef-juice. Intestines disinfected with small doses of calomel, and cleansed by high rectal injections of normal saline solution.

"On succeeding day fed upon:—

		Calculated Percentage.	
Cream, 16 per cent.	1 tablespoonful.	Fat	2.67
Milk	2 tablespoonfuls.	Albuminoids	1.29
Milk-sugar	1 teaspoonful.	Sugar	4.24
Salt	1 pinch.		
Water	6 tablespoonfuls.		

"For each feeding, every 2 $^1/_2$ hours.

"This was gradually increased in strength as the improvement, which was continuous, allowed, until at the end of a week the following was being taken:—

		Calculated Percentage.
Cream, 16 per cent.	1 tablespoonful.	Fat 3.55
Milk	4 tablespoonfuls.	Albuminoids ... 2.18
Milk-sugar	1 teaspoonful.	Sugar 5.24
Salt	1 pinch.	
Water	4 tablespoonfuls.	

"For each feeding, every $2\,^1/_2$ hours.

"There was no further trouble after the above domestic mixtures were employed; the evacuations became normal, and strength and weight improved rapidly, the food being increased in strength and quantity as increasing age demanded.

"*Second. Infantile Scurvy.*—This condition is an exceptional result of laboratory-feeding, but the possibility of its occurrence is of importance.

"The following notes were kindly furnished by Dr. W. F. Teller, in whose practice the case occurred:—

"Boy, born January 28, 1897; weight seven pounds. It being impossible for the mother to feed the child from the breast, he was placed upon laboratory-milk in the following proportions:—

Fat	1.00
Sugar	5.00
Proteids	0.75

"This was gradually increased in strength until by the middle of April (aged $2\,^1/_2$ months) he was taking:—

Fat	4.00
Sugar	7.00
Proteids	1.50

"Intestinal disturbance with green, mucoid evacuations containing curds ensuing, the food was changed to:—

Fat	3.50
Sugar	6.50
Proteids	1.50

"Eight feedings of $4\,^1/_2$ ounces each.

"On June 15th (aged $5\,{}^{1}/_{2}$ months) the weight was twelve pounds. The intestinal indigestion continuing, a further change was made:—

Fat	3.50
Sugar	6.50
Proteids	1.00

"Seven feedings of 5 ounces each.

"About one week later the child began to evince pain on moving or handling the legs, which were drawn up toward the abdomen and rigid; there were no fusiform swellings, and no petechial spots. Four incisor teeth were cut, and the gums about these were purple, swollen, spongy, and bleeding. There was diarrhœa, with green, curdled, and fermented evacuations; no fever.

"Orange-juice and raw beef-juice were ordered, with a simple treatment directed to the intestinal disturbance, and the scurvy symptoms gradually improved and soon disappeared entirely.

"After this until October (aged 7 months) he had:—

Fat	3.50
Sugar	6.00
Albuminoids	1.00

"Six feedings of $6\,{}^{1}/_{2}$ ounces each. Together with half an ounce of raw beef-juice once daily, given 'because it was necessary to keep the albuminoid percentage so low in the laboratory-milk mixture.'

"In October, as the child, though not ill, did not thrive, the beef-juice and laboratory-milk were discontinued, and a home-modified milk-food substituted, with the most satisfactory results.

"The question now naturally arises: Why should a food capable of being prescribed to approach so nearly breast-milk in chemical composition, so uniform in its make-up, so sterile and so easily and accurately varied to meet digestive emergencies, fail when put to a clinical test?

"My answer is that in its composition all the fat is removed by a separator, and the food as prepared for the infant is a recombination of this fat and an alkaline solution of the proteids and sugar. In a word, the natural emulsion is destroyed. This, I think, in some way lessens the digestibility of the proteids and leads to conditions either of malnutrition or to an irritative diarrhœa with the expulsion of the undigested proteids in the form of compact curds—and this, too, despite changes in the proportion of the proteids; for the partially-starved children are attacked with vomiting or diarrhœa with fever if the percentage of proteids be increased (say, to 2.00 per cent. at ten months), and those having irritative diarrhœa are not benefited until the percentage is cut down to a starvation-point (0.75 per cent. in a child of three months still showed numerous curds in the evacuations). What a contrast to normal breast-milk, an emulsion having over 2 per cent. of proteids (Leeds)!

"I have never seen an infant from two to ten months able to stand a laboratory-mixture of stronger proteid percentage than 1.50, and have often seen cases of two months and more unable to digest a percentage of 0.50.

"On the other hand, how does it stand with the cream, milk, sugar of milk, and water mixture made at home by capable heads and careful hands? These mixtures are still modified-milk mixtures; but their basis is unseparated milk, a natural emulsion, containing fat, proteids, sugar, and salts. Under this physical condition the proteids are much more easily digested; so that a badly nourished child of ten months, in whom laboratory-milk percentage cannot be forced higher than 1.50 proteids, will easily digest and grow strong upon a domestic mixture of:—

	Calculated Percentage.
Cream, 16 per cent......℥ss.	Fat.................3.75
Milk ....℥vss.	Sugar 4.94
Milk-sugar.............ʒj.	Proteids 2.97
Water ....℥ij.	

"And an infant of two months having an irritative diarrhœa on a starvation-diet of 0.50 per cent. proteids will begin to improve and soon grow strong and well on:

	Calculated Percentage.
Cream, 16 per cent......℥ss.	Fat.................4.00
Milk ....ʒx.	Sugar 6.22
Milk-sugar.............ʒj.	Proteids 2.09
Water ....℥iss.	

"In domestic modification, of course, the same care must be taken to secure clean, pure milk and cream from healthy, well-kept cows. This is quite possible now in Philadelphia, and is becoming easier each year, as more attention is being given to infant-feeding and greater demand is being made for a pure milk-supply. Pasteurization is as readily done in the nursery as in the laboratory. Accurate measurement of quantities and cleanliness of vessels and feeding-bottles is equally possible and, in my experience, quite as certain at home as in the shop.

"The milk and cream from a dairy may vary slightly in chemical composition from day to day, but this variation seems to me to be a minor detail, and of questionable importance when compared with the separator's destruction of the physical properties of the basal milk. One certainly would not sacrifice everything to chemical accuracy."

Clinical experience has demonstrated the fact that some children will thrive on condensed milk in spite of

faulty hygiene, while others will not thrive in the best environment with the best form of feeding; in other words, some children will thrive on modified milk, others will not. The majority of the cases seen by the writer suffered with intense constipation, having clay-colored stools, in one instance, in which two children in one family were constantly fed on modified milk of varying proportions, the formulæ were changed at least a half-dozen times with the usual increase of fat and sugar and lowering of the proteids, and in spite of this fact, after repeated trials, and no benefit, this feeding-method was abandoned. A child recently seen by the author *did not gain one ounce in four months.* This was one of the reasons that prompted the family to change both the physician and the food. The child, about two years old, was very pale, restless at night, quite peevish during the day, and decidedly backward in development. It could neither speak nor walk, although the teeth were well developed. From the time the modified milk was discontinued, and a nitrogenous diet given, the infant improved, and from last reports is quite well developed.

The records of the laboratory will probably show that, at the time the writer first used modified milk, he had at least a dozen at one time using the same, but his results were identical with those quoted by Dr. Louis Starr, of Philadelphia, and hence home-modification of milk has been used to the exclusion of laboratory-modification.

Do not let us blindfold ourselves with the belief that an infant is thriving unless our baby shows a regularity in the increase of weight, sleeps well at night, for at least from six to nine hours continuously, and, above all, assimilates its food, as evidenced by regular, unaided movements of the bowels; such movements should be once or

twice in twenty-four hours, have a yellowish-white color, and a mustard-like consistency. If the stool is hard or lumpy or pasty, like putty, then it is certainly abnormal, and shows improper food. The same is also true if the stool contains white particles of cheesy curds, showing a casein indigestion. In one infant, which had taken modified milk continuously for seven months, an obstinate constipation was only relieved after full doses of codliver-oil and extract of malt were given for several weeks—aided by massage, besides changing the diet.

PALLOR OF THE SKIN.

An unusual pallor of the skin, and also of the conjunctival mucous membrane, has frequently been noticed in modified-milk babies. In one instance an extreme leucocytosis was noticed for the treatment of which iron was given. An examination of a drop of blood showed a diminution of the red blood-corpuscles and an excess of the white blood-corpuscles. A decided hæmic murmur was noticeable in the vessels of the neck, in a child, two years old, which had been fed continually on modified milk.

Craniotabes, softening of the cranial bones, as well as very late closing of the anterior fontanelle has also been observed in some children fed with this form of food. A boy, 4 years old, a typical Walker-Gordon baby, who was fed exclusively on modified milk, now shows typical knock-knees, besides having been under the treatment of his physician for a general furunculosis of the scalp. The furuncles were of such size that they required incision several times; others opened spontaneously.

I have previously reported[60] "three distinct cases of

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[60] Pediatrics, July 15, 1896, page 68.

rickets in laboratory-fed babies, and if we compare the ordinary infant that we see brought to our dispensary from tenement-houses, children that are fed on condensed milk and water, they are much the same class of rickets at less expense." Thus, I fully agree with Louis Starr, of Philadelphia, who, in his paper,[61] says: "I must not be understood as condemning laboratory-milk absolutely; if its introduction has done nothing else, it has greatly advanced substitute infant-feeding, by fixing the attention of the profession upon the importance of cleanliness and accuracy in the quantity and chemical composition of cows' milk foods and by placing the whole question upon a higher scientific plane than it has ever reached before."

MATERNA HOME-MODIFIER.

This is a glass apparatus for the modification of cows' milk at home, and consists of a glass vessel with pouring-lip, shaped like a graduate, holding sixteen ounces. The outer surface is divided by vertical lines into seven panels; one panel shows the ordinary ounce graduation; the six others show six different formulæ, so arranged as to be suitable for the entire first year's feeding. On the following page is a more or less accurate reproduction of the arrangement of these panels.

It is possible to obtain other percentages than those shown on the panels, by mixing what is called for by two adjacent formulæ; as, for instance, equal quantities made according to Formulæ 1 and 2 combined will give: fat, $2\ ^1/_4$ per cent.; proteids, 0.7 per cent.; sugar, 6 per cent.

As may readily be seen, all the formulæ call for the

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[61] Archives of Pediatrics, page 7, January, 1900.

same ingredients, excepting the sixth, which, instead of water, requires barley-gruel, and granulated sugar in place of milk-sugar.

1. 3d-14th Day. Fat, 2%. Proteids, 0.6%. Sugar, 6%.	2. 2d-6th week. Fat, 2½%. Proteids, 0.8%. Sugar, 6%.	3. 6th-11th week. Fat, 3%. Proteids, 1%. Sugar, 6%.	4. 11 wk.-5 mo. Fat, 3½%. Proteids, 1½%. Sugar, 7%.	5. 5th-9th mo. Fat, 4%. Proteids, 2%. Sugar, 7%.	6. 9th-12th mo. Fat, 3½%. Proteids, 2½%. Sugar, 3½%.
Milk	Milk	Milk	Milk	Milk	Milk
Cream	Cream	Cream	Cream	Cream	Cream
Lime-water	Lime-water	Lime-water	Lime-water	Lime-water	Barley-gruel
Water	Water	Water	Water	Water	Gr. sugar
Milk-sugar	Milk-sugar	Milk sugar	Milk-sugar	Milk-sugar	
x	x	x	x	x	

The method of using the apparatus is extremely simple. Having decided upon the formula to be used, that panel is to be observed to the exclusion of all the others. The respective ingredients are then poured into the vessel, to the line below the designated substance. Thus, milk-sugar is put in first (or, in its absence, granulated; and the line with the cross shows to what point the latter should be used), then the water, lime-water,

cream, and milk in the order shown. The whole is then stirred, and the result will be a milk whose formula is at the top of the panel. The milk used with the apparatus should be good average milk. The cream should be the light centrifugal cream as obtained in bottled milk (16-20 per cent.). The water should be hot, to dissolve the sugar.

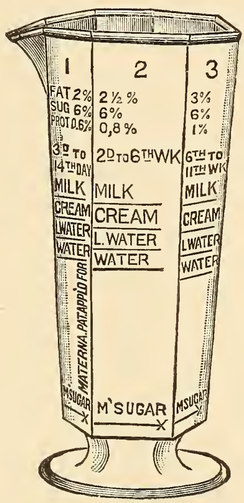

Fig. 37.

The barley-gruel should be prepared in the usual way with Robinson's or ordinary barley.

According to the age and size of the child, the vessel must be filled once, twice, or three times to obtain the quantity requisite for the twenty-four hours' feeding. The pouring into bottles and sterilization are then done as usual. Full directions, including a schedule for the twenty-four hours' feeding at the various periods of the

child's growth, accompany the apparatus, which is simple, accurate, and economical, making properly-modified milk of practical value obtainable in places where it has hitherto been impossible to get it.

The materna is adapted for home use only when the physician notes results. To intrust an apparatus of this kind into the hands of a mother or nurse not conversant with the difference in the percentage of fat contained in cream is not only wrong, but will prove disastrous to the infant so fed before many weeks are over. The author recently saw a case of dyspepsia brought about by feeding in this careless manner. On the other hand, the apparatus will serve as a guide to those physicians whose training in percentage-feeding requires occasional assistance.

CHAPTER XXXIV.

INFANT-STOOLS.

Stool of a Nursling.—The stool of a nursling or a baby on an exclusive milk diet should be yellowish in color, smeary or pasty-like in consistency, and have an acid reaction. The smell should be faintly acid, but not disagreeable. The color is due to bilirubin, and the reaction depends on the presence of lactic acid, the source of which is the milk-sugar. The only gases present are H and CO_2. According to Escherich, H_2S and CH_4, to which the odor of adult stools is due, are not present. There are no peculiar albuminoids. Those existing in mothers' milk seem to be entirely absorbed. Peptone exists in trifling amount. Sugar is not present. Pancreatic ferment is absent, and sometimes traces of pepsin have been found. Mucus is always present in considerable quantity; also columnar intestinal epithelium.

In the stools of nurslings large quantities of lactate of lime can be found; so also we frequently find oxalate of lime, depending on the quantity of oxalate of lime ingested. Uffelmann has noted the presence of bilirubin crystals in the stools of nurslings, in perfectly-healthy children.

Miller, who carefully studied the various micro-organisms in the mouth, found that most of them could again be found in the intestinal canal. He further found that certain germs possessed diastasic properties and were capable of producing lactic-acid fermentation. In the milk-fæces of nurslings Escherich found two germs;

the one he called bacterium lactis aërogenes (or bacterium aceticum, Baginsky) and the other the bacterium coli commune. In the meconium he found proteus vulgaris, streptococcus coli gracilis, and bacillus subtilis. The number of stools during the first two weeks is from 3 to 6 daily. After the first month the average is 2 stools daily; many infants have 1, others 3 stools daily. This latter is due largely to the excessive quantities of water given to infants.

Fig. 38.—Schering's Formalin Disinfecting-lamp. Well Adapted as a Deodorizer in the Nursery.

As soon as the exclusive milk diet is changed to the mixed diet we then lose the characteristic infantile stool and they resemble more those of an adult, though remaining softer and thinner throughout infancy. They become darker in color, assume the adult odor, and have more varieties of bacteria than those previously mentioned as found in the stool of a milk diet.

Reaction of Stools.—Reaction of stools in diarrhœal disease and in health is chiefly acid or, next in frequency, neutral. Alkaline stools are rare. Green-grass stools,

usually acid, are seen in the early stage of dyspeptic diarrhœa, the color from a pale greenish yellow to grass-green, owing to improper food.

Wegscheider has shown that the green color is the result of preformed biliverdin. The condition in the intestine, upon which the transformation of bilirubin into biliverdin depends, has been generally regarded as one of acid fermentation.

Experiments.—Pfeiffer's experiments[62] show this former opinion to be wrong. He found that none of the acids formed in such fermentation—lactic, acetic, butyric, propionic, etc.—added to yellow stools outside the body, turned them green, but that they made them deeper yellow. But dilute alkaline solutions added to fresh yellow stools turned them green after an exposure of thirty to sixty minutes, and strong solutions turned them, first, brown; later, after exposure to air, intense green.

Typical Green Stools.—Typical green stools can be produced by giving an infant 2 or 3 grains of bicarbonate of soda. This I have tried dozens of times; the soda must be given for a few days. This explains Pfeiffer's alkaline theory. Typical green stools can also be produced by giving small or even large doses of calomel. If, after having given bicarbonate of soda and produced green stools, we give diluted hydrochloric acid in 5- to 10-drop doses, the yellow color will in a few days again reappear. This is also true in giving rhubarb.

Stools. — Stools which are pale yellow when discharged, and which afterward become green, are often seen in disease. They may be themselves neutral or alka-

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[62] "Verdauung im Säuglings-alter bei Krankhaften Zuständen," "Jahrbuch für Kinderheilkunde," B. 28, page 164.

line in reaction; this latter may, however, depend on the admixture of urine. An excess of bile may often cause very green stools.

Brown Stools.—Brown stools may be due to changed biliary pigment and to drugs: *i.e.*, bismuth causes the well-known dark stool. So also tannic acid and all iron salts give the dark stool, which varies from a deep brown to a black color.

Blood in Stools.—Blood from the stomach or small intestine frequently gives the stool a black color resembling tar. Thus, a practical point in Boas's "Diagnostik der Magen- und Darmkrankheiten" is that, the brighter the color of the blood, the lower down near the rectum and anus must the pathological lesion be looked for; the darker the blood, the higher up must the cause be found: *e.g.*, the diseased conditions exist in the stomach, duodenum, jejunum, etc., if the stool contain black blood. If the corpuscular elements of the blood are wanting, then the presence of blood can only be positively diagnosticated by either a microchemical examination or by means of the spectroscope. The presence of red blood-corpuscles must always be regarded as a pathological factor.

Brown Stools; Muddy Stools.—A brown stool in an infant is frequently caused by a diet of animal food or by a diet principally of broth. These stools have no distinct consistency nor reaction. In dyspeptic diarrhœa or in some forms of enterocolitis we have very offensive stools, and they resemble muddy water; with the latter there is considerable flatus during each movement.

White or Light-Gray Stools. — White or light-gray stools usually are of a putty-like consistency, sometimes like dry balls on a diaper; sometimes they appear like ashes. Usually they are very offensive, consisting prin-

cipally of fat. In the latter there is scarcely a trace of bile, or the latter may be absent altogether.

Mucus. — Mucus is always present in all healthy stools, and is so well mixed with the stool that it does not appear as mucus to the naked eye. Any appearance, therefore, of mucus easily visible should be regarded as abnormal. Mucus is present in every form of intestinal disease. Very abundant in inflammatory conditions affecting the large intestine, more so than in those affections of the small intestine, and especially so in inflammatory conditions of the colon, both acute and chronic.

Jelly-like Masses. — Jelly-like masses of shreds of mucus, and where the stool consists chiefly of mucus, show that the affection is confined to the lower portion of the colon or that it is located in the rectum.

Long Shreds of Mucus.—Long shreds of mucus, frequently resembling false membrane, are often found in catarrh of the large intestine. If the shreds of mucus are intimately mixed with the stool, then we must look for the lesion quite high up, and if it comes from the small intestine it is usually stained from bile. If the lesion is low down the mucus is not intimately mingled with the stool.

Dyspeptic Stool. — The first change noticed in the dyspeptic stool is the increase of fat. Often the stool is quite green and contains small pieces, of yellowish-white color, which vary in size from that of a pin-head to the size of an ordinary pea. Hitherto, from their color, they were supposed to be casein lumps. Wegscheider has taught us that they consist principally of fat. Baginsky has shown that large colonies of bacteria are contained in these lumps of fat. Frequently they are so numerous that it looks as though the stool were composed only of

these cheesy lumps. They can be easily differentiated from real casein lumps by their solubility in alcohol and ether.

Fat Diarrhœa.—Biedert and Demme have devoted considerable attention to this subject.[63] In some children the fæces showed 50 to 60 per cent. of fat, whereas the normal percentage in ordinary fæces varied from 13.9 per cent. (which is the normal quantity), according to Uffelmann.

Casein is not nearly as common an ingredient of fæces as is commonly supposed, as I have previously stated. Casein lumps can be seen in abundance in the course of a diarrhœa during an exclusive diet of milk.

Quantity of Fæces.—The quantity of fæces varies, but it has been found that 100 grammes of milk-food will produce about 3 grammes of fæces, according to Baginsky. This is a vital point, but I have found it very difficult to determine, for in most cases the napkins of the infants are soiled with urine plus the fæces, thus adding to the gross weight.

Proteids.—The proteids of milk are so thoroughly absorbed that only small traces of them can be found in the fæces. Normal milk-fæces contain large quantities of bacteria, but chiefly two kinds, previously mentioned, viz.: bacterium lactis aërogenes (Escherich) and bacterium coli commune. Other germs, especially those of the proteolytic type (*i.e.*, those that render gelatin fluid), are not found under normal conditions.

Albuminous decomposition and its products—tyrosin, indol, phenol, and skatol—are not found in milk-

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[63] See Biedert: "Fett-Diarrhea," in "Jahrbuch für Kinderheilkunde," 1878.

fæces. But lactic acid, acetic acid, formic acid, and other fatty acids are present, causing the acid reaction.

Saccharin Ferment.—Von Jaksch found a saccharin ferment in the fæces of children.

Peptonizing Ferment.—Baginsky found a peptonizing ferment also in infantile fæces.

Escherich[64] says: "If albuminous decomposition with very foul offensive stools exists, these articles should be withheld from the diet and carbohydrates given, dextrin foods, sugars, and milk. If acid fermentation is present, with sour, but not offensive, stools, carbohydrates are to be withheld and albuminous foods given, such as animal broths, bouillon, peptones, etc. In the decomposition of milk, the sugar of milk, and not the casein, is usually broken up."

Holt[65] says: "Regarding the exact indications according to which fat, sugar, and proteids of milk are to be varied, much remains to be learned."

Sugar is Too Low.—If the sugar is too low, the gain in weight is apt to be slower than when furnished in proper amount.

Sugar in Excess.—Symptoms indicating an excess of sugar: Colic or thin, green, very acid stools, sometimes causing irritation of the buttocks; sometimes there is regurgitation of food and eructations of gas.

Excess of Fat.—Excess of fat is indicated by the frequent regurgitation of food in small quantities, usually one or two hours after feeding. Sometimes an excess of

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[64] "Jahrbuch für Kinderheilkunde," "Beiträge zur Antiseptichen Behandlungs-methode der Magen-Darmkrankheiten des Säuglingsalters."

[65] "Artificial Feeding," page 179.

fat causes very frequent passages very nearly normal in appearance. In some cases the stools contain small round lumps somewhat resembling casein, but really masses of fat. This has already been mentioned in speaking of the differentiation of true casein curds and small fat lumps by the solubility of the latter in alcohol or ether.

Dry, Pasty Stools.—When too little fat is given, it is indicated by hard, dry, pasty stools, and usually constipation. This can be easily remedied by the addition of cream three-fifths of which is fat. Holt speaks against increasing the fat above 4.5 per cent. in infants under six months old, and believes we should not go above 4 per cent.

CHAPTER XXXV.

Nathan Straus Milk-laboratories and Similar Charities.

Since 1894, through the generosity of the Hon. Nathan Straus, pasteurized, modified, and natural milk has been supplied from laboratories and milk-depots scattered throughout New York City. Some of these are found in the different parks of the crowded portions of our city. Hundreds of thousands of bottles are dispensed annually in New York and in neighboring cities. Thus, in a report of the Board of Health of Brooklyn for the year 1895, we find that in Brooklyn 42,739 bottles were used.

The infant-mortality has certainly been lessened during the last few years in these cities; a great deal of it is due to the education of the poorer classes living in tenement-houses, by means of these laboratories, to the necessity of using boiled food, or, call it sterilized milk, and boiled water. There are other factors which have lessened the great infant-mortality in New York City.

Do not let us forget the difference in the cleanliness of the streets of this metropolis due to the energetic work of the late Colonel Waring. The weeding out of blocks of tenement-houses, and the substitution of small parks in the heart of the tenement-district must certainly be considered. Whoever studies the development of rickets will find that it is not only the feeding which is the prime factor, but it is the environment, the faulty dwelling, with its foul air and general unsanitary condition, that con-

tribute to the poisoning of the air breathed by the infant; this poisoning is as distinct a *toxæmic condition* as it would be if a poison were injected directly into the body. Faulty food, be it breast-milk or cows' milk, is the prime factor.

Having been on continuous duty in the children's service of one of the largest clinics in this city for over ten years, the author has noted many, many changes. In recent years the large number of excursions, notably the St. John's Guild, which gives an excursion every day during the hot summer months to the poor destitute children of our city, has certainly added to the health of many little ones. There are also numerous sectarian excursions; so, for example, there is a Hebrew Sanitarium giving excursions to Rockaway every day during the summer. Then there are numerous church excursions and fresh-air funds, notably the New York Herald Ice Fund, all of which have a tendency to invigorate the lives of these poor infants, and in this manner they can withstand the terrible heat of the summer months, and survive it. The sanitary vigilance of the Board of Health of New York City has certainly improved the sewage and drainage, looked after the water-supply, and certainly benefited the city. These factors must be taken into account in studying the mortality and the population. The blessing for New York City will consist in giving it a pure, clean, and rich milk in which the stable, and cow, and milker's hands and all utensils are absolutely sterile. I cannot emphasize too strongly that the ideal milk of the future will not be sterilized milk, not pasteurized milk, but will be *pure, raw milk*. Nature supplies her infants in the human breast with raw milk at body-temperature; why must we feed our infants with boiled or steamed milk, especially so, when chemists have taught us that chemical changes take place in boiled

as well as in sterilized milk, rendering the milk more indigestible than it was in its raw state?

A vital point to remember is that the milk, when drawn from the cow, must be *quickly cooled* and must not be allowed to reach a temperature above 50° F. until used.

Such milk will not permit the development of bacteria—dangerous to health.

Rapid cooling, then,—to repeat again,—is as important as the absolutest assurance of cleanliness and sterility of every utensil brought in contact with milking,—so necessary to avoid introduction of filth or bacteria.

CHAPTER XXXVI.

Colic.

Colic is one of the most frequent causes of crying in children. They not only cry loudly, but will suddenly shriek, and when put to sleep will awaken with a sudden start, and cry loudly. The legs are usually flexed or they will move their legs back and forth, or up and down. They will seem to bend the body on itself. These attacks are usually associated with constipation; hence, it is a good plan, when the child is restless and utters a painful cry, to see if the bowels have moved. It is well known that this colic may be as well associated with diarrhœa. The origin of all colic is certainly the stomach. When dyspeptic conditions, arising from undigested particles of food in the stomach, exist, then fermentation, resulting in gas-formation, is the result. Colic is frequently known by the terms of "meteorismus or tympanites," but in the latter conditions the abdomen is greatly distended, and there is a permanent enlargement of it. Borborygmus can usually be made out, if the ear is applied to the abdomen. The vast majority of cases of colic have their seat in the intestine, and can be relieved very quickly.

Worms (ascarides) have been known to cause colic. Besides, when there is a general loss of tone on the part of the muscular layers in the walls of the intestine, colic will frequently result. Jacobi believes that chronic peritonitis resulting in adhesions, or such local changes in the walls of the intestine that will produce local contractions or dilatations, can cause colic.

The treatment of colic is simple when the cause is known. The quickest method of relieving colic is to give an enema of soap and water or of warm chamomile-tea.

I usually take an ounce of German chamomile-flowers and steep it in a quart of boiling water for from ten to fifteen minutes, and then strain. The injection is to be given in the same manner as will be described in detail in the chapter on constipation. My method is to allow 1 or 2 pints of chamomile-tea at a temperature of 100° to 110° (no hotter) to flow slowly into the rectum, and by all means the colon. When the colon is thoroughly flushed with this warm tea, and emptied of its fæces, it is usual for the attack of colic to cease. In addition to washing the colon, it is a good plan to apply a small bag of either chamomile-flowers or slippery-elm bark, or ground flaxseedmeal. To do this, I make a bag of cheese-cloth, capable of holding from 1 to 2 ounces, and then fill it with one of the above-mentioned ingredients; sew the bag shut when filled, and heat it before applying to the abdomen. Several of these bags can be made and kept in readiness, so that they can be applied quickly. It is a good plan to have one heating on the stove, while another is on the abdomen. These little bags are very grateful, and we are frequently rewarded by having the infant not only expel wind shortly after they are applied, but also frequently fall asleep.

MASSAGE.

During an attack of colic gentle massage with warm sweet oil or melted vaselin or lard will certainly be very comforting to the child. My plan is to take a bottle of oil, warm it by placing it in a kettle of warm water, and then to pour it on the abdomen. The distended abdomen should then be thoroughly kneaded, and the gas expelled. Then the warm applications mentioned above can be applied.

DRUG TREATMENT.

If the colic originated from a fermentative dyspepsia, then treatment must be directed to the stomach. For this purpose antifermentatives, like the mistura rhei et sodæ, should be given in doses of $^1/_2$ to 1 teaspoonful, diluted with water, every two or three hours until there is a thorough evacuation. Very good results will be found, after the bowel has been cleaned with the quart of chamomile-tea previously mentioned, by administering from 5 to 10 grains of bismuth; I prefer to use betanaphthol or the subnitrate; $^1/_2$-grain doses of resorcin will also be found useful. Paregoric in doses of 15 drops to $^1/_2$ teaspoonful should be administered with great caution to children of six months or older. It is self-understood that no physician will forget the danger of giving repeated doses of paregoric or permitting the same to be administered by incompetent people not aware of the dangers of the drug habit. The author has not only seen distinct opium poisoning follow the use of paregoric, but has also had occasion to see the distinct opium habit in very young children. This was reported by the author in a paper read before the New York County Medical Society, January 22, 1894, and which was published *in extenso* in the *Medical Record* of February 17, 1894. For an infant during the first few months, it is hardly safe to give more than 5 drops of paregoric repeated in an hour, if there is no relief. Another drug that has served the author very well is Hoffmann's anodyne in doses of from 1 to 5 drops, repeated in an hour if necessary. For an infant up to two months 1 drop per dose; from two to four months, 2 drops per dose; four to six months, 3 drops; six to nine months and until one year of age, 4 drops; children from

one to two years, 5 drops. This is to be given in a teaspoonful of sterilized water. Another valuable drug, and one that is to be given cautiously, and in the same doses as Hoffmann's anodyne, is spirit of chloroform; never should more than from 1 to 4 drops be given to a child up to one year of age, and younger children less in proportion. I cannot favor the administration of nauseating or foul-smelling drugs, such as asafœtida. We must try to cater to an infant's taste, especially so when in pain.

THE USE OF SUGAR.

When colic is caused by an excess of sugar, there will be quite some eructations of gas, and, frequently, small quantities of food will be regurgitated.

The stools, when an excess of sugar is given, are thin, greenish, smell very acid, and usually produce a reddened excoriation of the buttocks and around the anus.

When children show a tendency to the development of gas and have constant recurring colic, my plan is to discontinue the use of sugar, until such time when this fermentation is absent. To sweeten the food I use small, saccharin tablets, 1 tablet being ample to sweeten 1 pint of food. When there is a tendency to constipation, we cannot only sweeten the food, but modify this constipation by adding 1 teaspoonful of pure glycerin to each bottle of food prepared.

EXCESS OF PROTEIDS.

A careful observation of the stools would easily show whether the albuminoids are in excess, for they are usually present in the form of curds. This condition usually is associated with constipation, and the indication would be to cut down the quantity of curd administered.

CHAPTER XXXVII.

CONSTIPATION.

To CONSIDER the cause of constipation during the nursing period let us first look into the mechanical cause. Concetti,[66] in a very elaborate article, gives the various anatomical reasons for constipation. He states that Huguier, in the *Bulletin de l'Académie de Médecine,* had reported this same pathological condition several years prior to Jacobi, of New York. Thus, Huguier advises, as a practical point, that when a colotomy was to be performed in an infant it would be wiser to perform the same on the right side rather than on the left. He stated that it was much easier, owing to the greater number of flexures, to reach the same by operating on the right side in cases of atresia of the anus. Concetti further states that Jacobi, in 1868, reported in the *American Journal of Obstetrics* an elaborate article, which has since appeared in the "Therapeutics of Infancy and Childhood" (A. Jacobi, 1887), giving the anatomical reasons in detail. They are well worth noting:—

The embryonic intestine is formed in separate divisions. There is no ascending colon up to the fourth or fifth month of fœtal life. It is very short in the mature newborn. Despite this, the large intestine of the mature fœtus is longer in proportion than that of the adult. It is three times as long as the body of the fœtus, while it is only twice as long in the adult.

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[66] Archiv für Kinderheilkunde, vol. xxvii, 1899.

There is the same disproportion with regard to the length of the small intestine. The small intestine of the fœtus in the ninth month is twelve times as long as its body. The small intestine of the adult is only eight times as long as the body.

The colon ascendens being very short, the surplus of length, particularly as the transverse colon also is not long, belongs to the descending colon, and especially to the sigmoid flexure. Drandt found it between 8 and 24 centimetres in length, averaging from 14 to 20. I have seen a case in which it was 30 centimetres long.

As the pelvis is very narrow, the great length of the lower part of the large intestine is the cause of multiple flexures, instead of the single sigmoid flexure of the adult. Thus it is that, now and then, two or even three flexures are found, and to such an extent that one of them may be found to extend as far as the right side of the pelvis. Cruveilhier and Sappey speak of this position of the lower part of the intestine in the right side of the pelvis as an anomaly. Huguier finds it on the right side of the body in the majority of cases. Others only occasionally, although they admit the great length of the sigmoid flexure. In common with Huguier, who even proposes to operate for artificial anus in the right side, I have found one of the flexures on the right side many times.

The great length of the large intestine and the multiplicity of its flexures are of great functional importance. At all events, they retard the movement of the intestinal contents, facilitate the absorption of fluids, and thus the fæces are rendered solid. When this length is developed to an unusual extent, constipation is the natural result. In the *American Journal of Obstetrics*, August, 1869, I have described two cases in which the descending colon

was so long that the diagnosis of imperforate rectum was made. In one of them the operation for artificial anus was performed. Such cases and such errors are certainly very rare; still they are those in which normal anatomical conditions will lead to incidents of great pathological importance.

Other cases of constipation in the infant may be classed under four heads:—

First.—The intestinal mucus is deficient or too viscid. Such is the case in febrile conditions, now and then in chronic intestinal catarrh, and also when there is too much perspiration and secretion of urine.

Second. — Improper condition of food. A superabundance of casein, particularly cows' casein; of starch; the absence of sugar, and the administration of astringents and iron.

Third.—Incomplete peristalsis, such as exists in the rachitic debility of the muscular layer, in the muscular debility dependent upon sedentary habits and peritonitis, intestinal atrophy, and hydrocephalus.

Fourth.—Mechanical obstruction. Cystic tumors in the intestine. There is, further, intussusception and twisting of the intestine, incarcerated hernia, even umbilical hernia, hardened fæces, and imperforations.

In all these cases the diagnosis should not be made without manual examination. In most of the cases the abdomen is inflated, though it be painless. The fæces come away in small, hard lumps or in large masses. The liver and spleen are displaced. The liver may be so turned that a part of its posterior surface comes forward. The abdominal veins are enlarged to such an extent that they form circles around the umbilicus, similar to what is seen in hepatic cirrhosis. These children lose

their appetite, sometimes vomit, and the irritation produced by the hardened masses in the intestinal canal may be such as to finally result in diarrhœa, which, however, is not always sufficient to empty the tract.

There is, besides, an apparent constipation, which should not be mistaken for any of the above varieties. Now and then a child will appear to be constipated, have a movement every two or three days, and at the same time the amount of fæces discharged is very small. This apparent constipation is seen in very young infants rather than in those of more advanced age. Such children are emaciated, sometimes atrophic. They appear to be constipated because of lack of food, and not infrequently this apparent constipation is soon relieved by a sufficient amount of nourishment.

Constipation resulting from a superabundance of starch in the food is easily cured by the withdrawal of the latter.

Constipation produced by too much casein in the food will be relieved by diminishing its quantity. The proportion of casein in the food of infants should never be more than 1 per cent. Besides, this amount of casein ought to be copiously mixed with a glutinous decoction.

Infants that have been fed on starchy food or even such cereals as barley, should have oatmeal substituted for the barley.

Constipation depending on lack of sugar is very often speedily relieved by increasing the quantity of sugar in the food. This is the case, not only in artificial feeding, but also when the children are fed normally on breast-milk. Such mothers' milk as is white and dense, and contains a large amount of casein, is made more digestible, and will produce better evacuations, when a piece of loaf-

sugar dissolved in tepid water is given immediately before nursing.

As there is frequently a large excess of acid in the intestine, magnesia with or without rhubarb will frequently relieve the acidity and cause a movement of the bowels.

In a previous section on "Cream" I have already spoken of the deficiency of fat, which is one of the most frequent causes of constipation. Hence, in an infant nursing at the breast it is wise to give the child a teaspoonful of raw cream immediately before taking the breast to correct the constipation. Cream consists of so much fat that in this manner we add fat directly to our food. This is the secret of success attained by some authors when they advise giving codliver-oil, butter, olive-oil, or fried bacon to very young children. Each one desires to remedy the deficiency of fat in his own particular manner.

A DRINK OF WATER.

From infancy, when the child is but a few days old, we should make it a rule to give it a drink of water; thus a very small infant during its first week can be given two to three teaspoonfuls of boiled water during the day. A safe plan is to give this drink of water when it is not time for feeding, and if the child appears restless. It is understood that we must first satisfy ourselves that the child has not had a stool, is not lying in a soiled napkin, and that other conditions—such as colic—do not cause uneasiness in the baby. When a child is several months old, the quantity of water can be increased from teaspoonfuls to as many wineglassfuls. Frequently have I noted

the disappearance of a continued constipation after giving an infant its "drink of water" regularly.

IMMEDIATE RELIEF OF CONSTIPATION.

A rule that I have always followed, and one that I lay stress upon, is never to allow a child to retire at night without having had a movement of the bowels during the day. The reason for this is plain; not only will the accumulated fæces and gas cause flatulence, colic, and uneasiness, but this constant distension of the bowels will dilate the intestines to such a degree that frequently a permanent pendulous belly remains.

My plan is to order an injection of a half-tumbler of ordinary glycerin mixed with a pint of warm water,—temperature, 100°,—and allow this quantity to flow into the rectum by using a fountain-syringe, the end of which has the smallest infants' rectal nozzle. In this manner we have a rapid emptying of the rectum and colon, and can be assured of temporary and possibly permanent relief. It is not absolutely vital to use glycerin and water, for a similar result can be obtained if we make soap-water by rubbing up a piece of Castile soap with a pint of warm water, or using glycerin soap with the equal quantity of water, if the latter can be procured.

Continued Use of Enema.—In obstinate cases it is well to slip a soft-rubber rectal tube over the nozzle, and, having anointed the rubber tube with vaselin or glycerin, the same can be pushed slowly into the rectum, then allow about half a pint of water to flow into the rectum, which will distend it gradually, and, by simply pushing the tube farther into the colon, we can allow the balance of 1 pint or more to flow directly into the colon. The continued use (daily) of these enemas is not fraught with danger;

on the contrary, these rectal injections can be used for months. In safe hands, if the mother or nurse is intelligent, there should not only be no injury, but positive good, from its continued use.

REMOVAL OF SCYBALA.

Hardened round balls or fragments of fæces will frequently be caused when the stool remains very long in the colon, or when the sigmoid flexure has an unusual length; in such instances the injection of either $^1/_2$ pint of lukewarm sweet oil or glycerin will soften these scybala and aid in their expulsion. At times these balls will be as hard as marbles, and may require the aid of a small scoop (a very small teaspoon will do) to aid in their removal.

DRUG TREATMENT.

A great many drugs are indicated and counter-indicated in the treatment of constipation. The intelligent practitioner does not desire merely one movement of the bowels, brought about by drugs, but seeks rather to use such therapeutic measures which will give a permanent cure. My choice of drugs is the following:—

℞ Ext. cascara sagrada fl., ℥j.
Glycerin, ℥j.

Mix. Twenty drops of the above mixture in a teaspoonful of water three times a day, for children about three months old. At the age of six months, double the dose, or 20 drops three times a day. At the age of one year a teaspoonful three times a day.

My plan is to give the firse dose in the morning before the feeding, and note the result. If the bowels move by noon-time then I discontinue the dose at noon, and give a second dose in the evening. If, however, there is no effect by noon-time, then I continue my second dose, and follow with my third dose in the evening. Thus, it will be

apparent that, if one dose answers for the day, then we should discontinue the medicine for that day, but commence again on the following day, and keep up this form of drug treatment until it is apparent that the bowels are not as sluggish in their action as before. Another drug which has been one of my stand-bys for many years is nux vomica; thus, I give 1 drop of the tincture of nux vomica in a teaspoonful of sterile water three times a day, for an infant up to one year of age. Children of two years I give 2 drops three times a day. From three to six years, 3 drops three times a day. Six to ten years, 4 drops three times a day. Ten to fifteen years of age, 5 drops three times a day. Nux vomica is always to be administered on an empty stomach. In other words, before feeding. Another valuable drug is rhubarb in the form of the aromatic syrup of rhubarb. From $^1/_2$ to 1 teaspoonful once or twice a day, repeated every two days, will frequently afford relief.

Powdered rhubarb and magnesia, given in teaspoonful doses to very young children, is one of the best laxatives and antifermentatives that we possess. It is especially indicated for the relief of colic.

Citrate of magnesia, given in wineglassful doses to children over one year of age once or twice a day, can also be recommended.

In atonic conditions of the bowels depending on general weakness, strychnine, given in $^1/_{200}$ grain twice a day, will be found useful. This may or may not be combined with iron.

The infusion of senna-leaves is made by boiling a heaping teaspoonful of ordinary senna in a teacupful of boiling water for fifteen minutes, straining, and when cool adding 1 tablespoon of glycerin to 5 tablespoons of this

infusion of senna. This quantity to be administered in three doses at intervals of four or five hours. In some instances the addition of syrup of manna will be found advantageous in sweetening the infusion of senna.

Certain drugs should not be given. Of these castor-oil may serve as a type. The constipating effect following the use of castor-oil is so well known that this drug is indicated when we wish to cleanse the stomach and bowels and remove stagnant food, as, for example: in fermentative dyspepsia accompanied by diarrhœa. Thus, we not only have an effective movement, but a constipating effect following the same. The use of drastic cathartics—such as scammony, elaterin, or podophyllin—should not be thought of in the treatment of infants and children. Very rarely do I use aloes, owing to its offensive taste. It is understood that calomel is only to be given when we wish to cleanse and produce an antiseptic effect in the intestine, but, for the treatment of constipation *per se*, calomel is entirely out of place.

Suppositories. — Among those most commonly used are suppositories of the glycerin and gluten type. Most suppositories in the market are entirely too large, and frequently must be cut into halves and quarters. The suppository made by Parke, Davis & Co. has served the author very well. It should be distinctly understood that a suppository is to be used in the evening for the same relief as we desire from the injection or enema previously mentioned. Neither the suppository nor the injection should be used with the idea of curing a constipation.

MASSAGE.

Continued kneading of the abdomen with the aid of vaselin or oil will be found serviceable, and, if properly

done, will provoke an action of the bowel. Thus it is that rubbing the abdomen with castor-oil has frequently been recommended in the treatment of constipation; the effect supposed to be due to the castor-oil is, in reality, due to the massage, and to nothing else. When massage is used, it should be continued from five to ten minutes every day for one month, morning and evening. This will certainly aid and stimulate peristalsis, and ultimately tone the muscles and cure the constipation.

ELECTRICITY.

This is very valuable to stimulate peristalsis. The faradic and galvanic and static currents can be used. For the general practitioner the use of the galvanic current, five to ten cells, is sufficient. The negative pole (cathode) should be applied in the rectum, and the positive pole, which produces peristaltic waves, should be applied over the ascending, descending, and transverse colon. Local contractions result from the negative pole. A gentle faradic current applied over the spine and the abdomen will answer if used for several minutes in the absence of the galvanic current. Galvanic electricity should be used every day; frequently months are required to insure a cure, in conjunction with the medicinal and dietetic treatment.

DIETETIC TREATMENT.

We have previously mentioned the value of cream, and the addition of water for the treatment of constipation. In bottle babies it is well to remember that oatmeal-water and sago-water should be used when constipation exists. Under no condition should barley or rice be given, as the latter will simply increase the constipation.

Older children should be given fruit, baked apples, peaches, prunes, grapes, and oranges, and avoid pears. Buttermilk will be found serviceable, as well as koumiss, for the relief of constipation. Sugar (cane-sugar) will be found quite serviceable, when added to water, for the relief of constipation in nursing or bottle-fed babies. Thus, a good plan, according to Jacobi, is to give a small piece of loaf-sugar dissolved in water immediately before nursing, and to substitute and use cane-sugar instead of milk-sugar for bottle-fed babies.

Having regulated the diet and excluded fresh bread, cakes, pies, pastries, macaroni, and other floury foods, we should insist, in children over two years of age, on eating all green vegetables with the exception of cabbage, beans, turnips, potatoes, and corn. Thus, celery, spinach, green pease, asparagus, and cauliflower are recommended.

EXERCISE.

What massage is for a young infant exercise is for an older child. Thus, it is apparent that atonic conditions can best be relieved by combining the dietetic and medicinal treatment with out-of-door exercise. Children should be permitted to romp about and walk and play out-of-doors, but not to a point approaching fatigue. Older children will find bicycle exercise or horseback-riding decidedly beneficial. It is important, however, to regulate the amount of such exercise, and thus it is apparent that it is the physician's duty to tell the mother or nurse just how long a child should be permitted to exercise. It would seem that one-half hour twice a day is ample to arrive at beneficial results. Over-indulgence in such sports will frequently result in rupture and producing heart-strain. In cardiac lesions, in asth-

matic conditions, if children suffer with whooping-cough, and in tuberculous conditions such exercises must not be allowed.

HYGIENIC TREATMENT.

We should insist on proper ventilation of a child's sleeping-room at night, and it is, therefore, advised that the window be left open a few inches. This is not fraught with danger; on the contrary, it is healthful and beneficial to allow children to play in the open air all day, and naturally to shut them up in poorly ventilated apartments at night is simply inviting both throat and lung trouble. In addition to proper ventilation, bathing in cool water or lukewarm water, followed by an abdominal spray or a douche directed against the stomach and bowels, will be found advantageous in the correction of this ailment. Following the bath, friction with a good, coarse, Turkish towel will be found useful. My preference has always been for a lukewarm bath, followed by a cold douche for a few moments, every morning, and then to have the child properly rubbed until the skin is reddened with a Turkish towel, followed by massage with oil or vaselin.

CHAPTER XXXVIII.

Statistics.

The recorded births of the three years 1890, 1891, and 1892, according to the New York Board of Health, were 135.602.

It is estimated that this represents only five-sixths of the actual number born; so that 162,721 would really represent the actual number of births for this period. During the same time the number of deaths of children under five years of age were 52,213, representing over 32 per cent. of the whole number of births.

In July, 1893, the deaths of children under five years of age numbered 2796. During the same months of 1894, 2562. In August, 1893, there were 1686. In August, 1894, 1559. During eight months ending in August the deaths under five years of age were: 1895, 13,287; 1896, 12,734; 1897, 10,962. During June, July, and August of 1896 there were 5671 deaths. During the same period of 1897, 5041. "1897 was a cool summer."

The following tables, compiled from the vital statistics of the Board of Health, show the relative death-rate and the infant-population in New York City.

Deaths and Death-rates of Children under Five Years of Age, for the Months of June, July, and August.

Year.	*Population.*	*Deaths.*	*Death-rate.*
1891	188,703	5,945	126.0
1892	194,214	6,612	136.1
1893	199,886	5,892	117.9

Year.	Population.	Deaths.	Death-rate.
1894	205,723	5,788	112.5
1895	212,983	6,183	116.1
1896	216,728	5,671	104.7
1897	220,641	5,041	91.4
1898	224,736	5,047	89.8
1899	229,029	4,689	81.9
1900	233,537	4,562	78.1

Population, Deaths, and Death-rates of Children Under Five Years of Age from 1891 to 1899 in New York City.

Year.	Population.	Deaths.	Death-rate.
1891	188,703	18,224	96.6
1892	194,214	18,684	96.2
1893	199,886	17,865	89.4
1894	205,723	17,558	85.3
1895	212,983	18,221	85.6
1896	216,728	16,807	77.5
1897	220,641	15,395	69.8
1898	224,736	15,591	69.3
1899	229,029	14,391	62.8

The number of deaths until October 1, 1900, was 12,825; ratio about 70. This mortality is higher than in 1899, but during first four months of this year there was an excessive amount of respiratory diseases, prevalence of grip, and also infectious diseases.

The author desires to thankfully acknowledge the kindness of Drs. Guilfoyle and Taylor, of the New York Health Department, in furnishing the above statistics.

CHAPTER XXXIX.

Rachitis (Rickets).

Prof. Paul Zweifel, in his recent work (1900) on the above subject. says: "That the addition of water to raw milk aids in the digestion of the same, whereas, the addition of an equal quantity of water to boiled milk, produces just the opposite effect." Thus it would appear, from the experiments of this author, that raw cows' milk diluted with an equal quantity or even more water will be much easier assimilated than diluted boiled milk.

Zweifel agrees with Schlesinger, of Breslau, "that the addition of water to milk does not render it more digestible." Clinical investigations by such authorities as Professor Baginsky, in Berlin, have proved conclusively that whole milk (undiluted) cannot be fed to infants with weak digestive powers or those suffering with dyspepsia without aggravating the dyspeptic conditions and threatening the very existence of the child. Time and time again has the author tried to increase the weight of children and to strengthen them by giving them more concentrated food. These experiments would have proved disastrous in winter but for the rapid withdrawal and substitution of the requisite diluted milk solution necessary for the age of the infant.

THE ADDITION OF TABLE-SALT.

The addition of table-salt has given such satisfactory results when added to milk that Zweifel insists on its advantage in preventing rickets. When a large-size thimble is filled with salt it will hold about 3 grammes. The smaller thimbles will hold about 2.5 grammes of

Fig. 39.—Funnel-shaped Depression of Sternum. Rachitic Kyphosis. Deformity of Spine. Picture also Illustrates Rachitic Square Head. (From Author's Service in Children's Department of German Poliklinik.)

salt. If this quantity (3 grammes) of table-salt is added to 1 pint of water (500 cubic centimetres), then we have a solution approximating the decinormal salt solution commonly known as the physiological normal salt solution. Zweifel maintains that both sterilizing and boiling the milk, according to the Soxhlet method, does not render it more indigestible. On the other hand, he believes that the albuminoids of the milk are rendered more difficult to digest, and thus he believes that boiling might be a factor in producing rickets.

Rickets is caused by the substitutes for milk rather than by milk itself.

When children are improperly fed so that the body is underfed, muscle- and bone- formation will be slow. Thus it is that the eruption of the teeth will be delayed, and this is one of the most prominent symptoms of rickets. The bones show the most characteristic result of improper nutrition, for they are very soft and spongy. They will yield to the weight of the body if used in walking, and thus it is that bow-legs with extensive curvatures form such a prominent feature in showing the result of using soft bones. The most typical symptoms can be studied on the head and spine. Thus, craniotabes can be explained by a deficient nutrition in which the cranial bones will be found so soft that they will yield to the pressure of the thumb. The cranial bones will frequently be found to be as soft and as thin as pasteboard. The spine is most frequently deformed, and will show a typical rachitic kyphosis.

CAUSES.

The majority of children suffering with rickets are or were bottle-fed children. Thus it is apparent that no food can equal breast-feeding, be it mother or wet-nurse,

in preventing rickets. There are a great many other causes, such, for example, as bad sanitary measures and faulty hygiene. Breast-fed children will sometimes show rickets when they have been living in bad apartments, breathing foul air, and not being properly cared for. One of the most frequent causes of rickets is "prolonged" nursing. In the section on "Breast-feeding" I have already pointed out the necessity for making a proper chemical examination of the breast-milk if the infant "shows no increase in weight." We know that, toward the end of lactation, not only do the proteids diminish, but get to such a low percentage that, unless we combine hand-feeding by adding the raw white of egg, steak-juice, and other proteids, like the cereals, to the nursing, the child will be underfed. This underfeeding is certainly a contributing factor, both to the causation and leading to the development of rickets.

Children that have suffered prolonged diarrhœas or with severe diseases—like dysentery, typhoid, bronchitis, and pneumonias—are prone to the development of rickets. Children of syphilitic parents and whose parents are tuberculous are more prone to the development of this disease. Von Ritter, quoted by Professor Baginsky, says that, in twenty-seven cases out of seventy-one examined by him, rickets was not only found in the children, but as well in the mothers of these same cases. Thus it is that Kassowitz and Schwarz[67] have mentioned the existence of congenital rickets. This same author found that 80 per cent. of children born in the Vienna Lying-in Hospital were rachitic. This statement is not so easily accepted, however, for both Professors Baginsky and Virchow do

[67] "Wiener medicinische Jahrbucher," 1887, vol. viii.

Fig. 40.—Rickets, showing Beaded Ribs. Breast-Fed Infant with Poor Hygienic Conditions and Delicate Mother. (From Children's Service of German Poliklinik.)

not accept the same. Experimentally, it has been found as long ago as 1842 by Chossat that when lime is deducted from the nourishment of young animals not only soft bones result, but they finally die. Heitzmann maintains that, if lactic acid is introduced into the food of young animals, the result will be, first, rickets, and, later on, osteomalacia will result therefrom. Clinical investigations have shown that cases of rickets occur more often during the winter months; thus it is apparent that improper ventilation is one of the most exciting causes of this disease.

The prognosis of infants suffering with rickets depends upon the amount of damage already done. If deformities of the spine, of the head, of the legs, and arms exist, careful orthopædic treatment will certainly modify the condition. The backbone of the treatment will, however, consist in studying "the dietetic requirements of the case." In this disease more than in any other will the advantages of a carefully-regulated diet be apparent, if the hygienic factors and proper medicinal treatment are included.

Rachitic children require milk, meat, and eggs; plenty of cereals, like wheat, barley, rice, farina, sago, oatmeal, hominy; they require butter, and, if they will not take butter, then codliver-oil or lipanin; iron will be found valuable, as well as Fellows's hypophosphites; malt-extract and ferrum lacticum are indicated. Great emphasis must be put on the value of fresh air and sunshine in the treatment of this disease.

EXTERNAL TREATMENT.

Bathing in sea-salt, taking 1 to 2 pounds of salt to a bath-tub of water, to which malt-extract, about 1 teacup-

ful, is added; in the place of malt Baginsky advises 2 ounces of calamus-root. I have seen very good results follow the continued use of bran and sea-salt, of which 2 to 3 pounds of bran and a pound of sea-salt are placed in a bag made of cheese-cloth. This bag is put into the bath-tub one-half hour before putting the baby in it. Enough water is then added to bathe the child; the temperature of the bath to be from 80° to 100°, my preference being for a cool bath, really tepid, temperature of 80° F.; duration of bath, from 10 to 20 minutes, followed by a good, brisk rub with a coarse, Turkish towel.

Massage of the muscles aided by passive movements will be found very valuable in producing a better muscular development, aiding metabolism and stimulating the circulation in general. The great susceptibility of rachitic children to colds and coughs, especially to croup, can certainly be modified if such children will be given cold baths, cold sponging, cold spray, or a cold douche. Such children should not be overbundled with clothing, and while I insist on protecting the lungs and the whole body from sudden changes in the weather, the use of too much clothing will certainly tend to increase the amount of perspiration, and thus add to, rather than mitigate, our trouble.

Kassowitz Formulæ.—

1. ℞ Phosphori puri, 0.01.
   Ol. amygdal., 70.00.
   Sacch. alb., 30.00.
   Æther. fragar., gtt. xx.

2. ℞ Phosphori puri, 0.01.
   Solve in ol. amygdal. dulc., 10.00.
   Pulv. gummi arab., 5.00.
   Sirupi simpl., 5.00.
   Aq. dest., 80.00.

Fig. 41.—Showing Rachitic Beaded Ribs on Left Side of Thorax.

3. ℞ Phosphori puri, 0.01.
Ol. amygdal., 30.00.
Pulv. gummi arab., 15.00.
Sacch. alb., 15.00.
Aq. dest., 40.00.

Of the above mixtures, 1 to 2 teaspoonfuls per day; so that children would receive $^1/_2$ milligramme (0.0005) of phosphorus, and in prescribing 100 grammes of codliver-oil or in the emulsion containing the above-mentioned dose of phosphorus the quantity would last twenty days. Formula No. 1, given by Professor Kassowitz, of Vienna, does not mix well; neither does Formula 3; so that Formula 2 is the only one available for practical purposes, and may be used. A chemical test for the presence of phosphorus will always yield a positive result. Thus far the specific action of unoxidized pure phosphorus has not yet been proved. In fact, such keen observers as Baginsky and Henoch do not believe that phosphorus in its pure state is applicable.

A very valuable drug in the treatment of rickets is the following: Glycerophosphate of lime, in doses of 1 to 5 grains for an infant one year old, to be given immediately after feeding. For a child six months old one-half the dose.

When this disease is associated with anæmia or very great weakness or where it is desirable to tone up the general system, then add to the glycerophosphate of lime an equal dose of the glycerophosphate of iron. This drug treatment should be continued for several months before expecting results. It is self-understood that the author insists on a radical change of diet, and also the strictest hygienic treatment, when possible. All factors will be more essential than merely giving an infant a few doses of drugs.

CHAPTER XL.

Dentition (Teething).

The teeth usually appear, according to Professor Baginsky, between the third and tenth months. Usually though, between the ninth and tenth months. The usual rule is for normal dentition to begin about the seventh or the eighth month.

In a great variety of children premature teething is recorded; then I have seen a great many children born with two and more teeth.

Rachitic children, as a rule, teeth very early or very late.

In the large children's service with which I have been connected I have observed the eruption of teeth many times as early as two or three months in very rickety, bottle-fed children. These teeth soon decay, and are then known as carious teeth.

In syphilitic (congenital) children premature dentition is frequently seen. The first teeth are known as *milk-teeth.*

The following table will show the usual rule followed by normal dentition in the average child:—

19	11	13	5	3	4	6	14	9	17
20	12	15	7	1	2	8	16	10	18

The milk-teeth are twenty in number; thus, 1 and 2 are the lower incisors, usually first teeth; then follow 3 and, 4 upper incisors.

Normal children usually teeth in pairs, and not singly, whereas rachitic children usually have an eruption of single teeth, and distinct backwardness in their appear-

ance. Milk-teeth remain until a child is a year old, when they give place to permanent teeth.

Baginsky emphasizes the fact that enough stress is not laid on the clinical importance of carious teeth as indicating tuberculosis and scrofulous conditions. In my section on treatment of rickets I have mentioned the value of a nitrogenous diet, especially proteids (albuminoids), to aid in the formation of bony structures. The teeth are also included in this category.

Fig. 42.—Two Middle Lower Incisors. Three to 10 Months; Average, 7 Months.[68]

Thus, when such drugs as glycerophosphate of lime or iron and hygienic measures are indicated for the treatment of rickets they are of especial value where backwardness in teething exists.

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[68] I am indebted to the kindness of Dr. Dillon Brown for the illustrations, which have recently appeared in "The Nursery."

Fig. 43.—Nine to 16 Months. Four Upper Incisors.

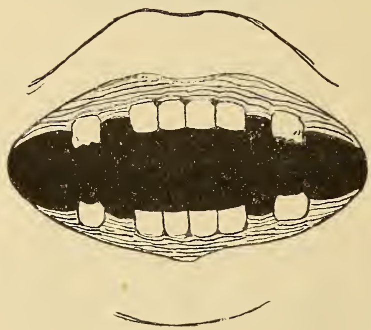

Fig. 44.—Two Lateral Lower Incisors and 4 Anterior Molars. Thirteen to 17 Months.

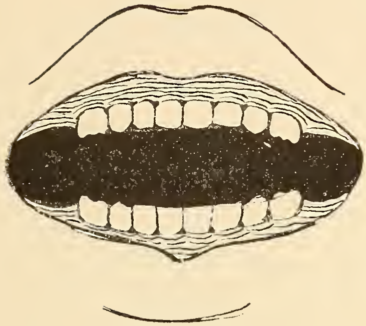

Fig. 45.—Four Canines. Sixteen to 21 Months.

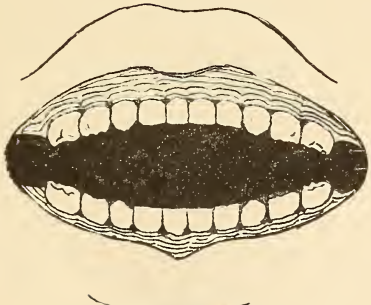

Fig. 46.—Twenty-three to 36 Months, although the Average is 24 to 30 Months.

CHAPTER XLI.

ATHREPSIA INFANTUM. (MARASMUS, OR ATROPHY; WASTING DISEASE, OR MALASSIMILATION OF FOOD.)[69]

IF infants, when a few months old, suffer with vomiting or diarrhœa, and this condition is allowed to become chronic, then colic and flatulence, associated with constipation, supervene, and result in a gastro-intestinal catarrh. Neglect of this condition means the development of the condition known as athrepsia. The infant does not thrive, commences to waste, and, unless we realize the condition and give the baby proper treatment, such a child will die of exhaustion from inanition. When these cases linger for months, they develop rachitis. Recovery without treatment is impossible. Parrott was the first to define this disease, and classified it into three stages:—

1. The infant suffers from a simple diarrhœa or looseness of the bowels. The stools, instead of being bright yellow and homogeneous, are liquid, curdy, often of a green color, and contain an excessive quantity of mucus. The abdomen is distended with gas and remains constantly in this condition; the tongue is coated and the patches of a stomatitis appear in the mouth. The infant is restless, constantly whining, and will not sleep at night. The milk, being retained, curdles; the tissues become flabby, and wasting commences.

2. The symptoms are intensified and the character-

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[69] Presented to the Section on Diseases of Children, at the Fifty-first Annual Meeting of the American Medical Association, held at Atlantic City, N. J., June 5-8, 1900.

istic wasting becomes manifest. The stools, for the most part, are loose and frequent, and consist of undigested food; they are often pale and putty-like, with a peculiar odor. At other times they are dark brown, from the presence of altered bile. The infant is most voracious. liquid food does not seem to satisfy it, and by the mistaken kindness of its friends it is fed with some thick food, like soft bread, a diet which has the great advantage, in their eyes, of keeping it quiet for a longer time than liquid food or diluted milk. At times it can hardly be made to sleep, or only dozes for a short time, unless under the influence of a soothing-syrup applied by its nurse. The mouth becomes the seat of a parasitic stomatitis; the skin is harsh and dry; small boils or a lichenous rash makes its appearance. The buttocks and genitals are raw and excoriated. Its temperature is below normal; the feet and hands are congested; the face has a pallid, earthy tint; and a sickly lactic-acid smell is given out from the body, especially the abdomen. The wasting is extreme, the face being shriveled, the skin wrinkled and hanging in folds about the thighs and arms.

3. The third stage brings the child into a moribund state. It is too feeble to cry, becomes heavy and drowsy, taking little notice of anything. Death then ensues, probably preceded by a muscular twitching, strabismus, or general convulsions.

Henoch does not like the term "athrepsia," introduced by Parrott, but prefers "atrophy." The first symptom that this author noticed is that the child's weight does not increase; and hence he emphasizes the importance of frequently weighing children. He regards the weight taken once a week as sufficient, so that it can be a determining factor as to the progress made by an infant.

Henoch says that at the end of the first month the weight is increased one-third, at the end of the fifth month it is double, and at the end of the twelfth month it should be three times the weight at birth. Weaning, dentition, and all other pathological conditions interfere with a proper increase in weight.

By far the greatest number of cases of athrepsia are found in bottle-fed children. There are, however, a great many cases to be seen among breast-fed children. We can then be positive that the breast-milk is lacking in some of its chemical constituents, and frequently we find that it is the proteids that are deficient in quantity. If, therefore, we meet with a case of athrepsia in a breast-fed child, the thing to do is to have a chemical examination made of the breast-milk. If the latter is found deficient in quality, then we must withdraw it.

A great many children will be found to thrive at once after having been removed from the breasts and changed to some artificial mode of feeding, whereas the reverse is also true. If, therefore, we wish to do away with its own mother's milk, for some positive reason, it is advisable to secure a wet-nurse having a child as near the age of the one she is to suckle as possible. The hereditary history of a nurse is of great importance, as is also the quantity and quality of her milk, which should be thoroughly examined before she is given this foster-child.

The treatment of this disease is one which resolves itself into removing the cause, and if bad hygienic surroundings—as impure air, crowded apartments, and improper diet—are the cause, then these must be remedied at once. Medication amounts to nothing in the treatment of this disease.

With hand-fed or bottle-fed children we can easily

Fig. 47.—Athrepsia Infantum.

regulate the condition of their bowels, and also easily regulate the quality and quantity of the food given them. The blandest and least irritating food must be selected, while frequent weighing of the infants should be resorted to in order to ascertain the progress that is being made.

Where there is much diarrhœa, milk must be used sparingly or altogether omitted for awhile, as the hard curds formed in the stomach are beyond the weak digestive powers of the weakened stomach and intestines. Small quantities of whey and barley-water, white of egg and barley-water, or the juice of a rare chop or steak may be given at short intervals during the day and night.

As soon as the child improves in respect to the diarrhœa, milk in some form may be allowed. Peptonized milk is often of much value in these diseases when made by mixing 3 ounces of cold milk, adding 2 teaspoonfuls of cream, with $^1/_2$ of a peptonizing powder, and given to the infant after it has stood for fifteen minutes.

The cream-mixtures are often of much service, such as 1 ounce of cream, 3 ounces of barley-water, and 1 teaspoonful of sugar. Every care must be taken that the feeding-bottle is clean, and the food prepared with the most scrupulous neatness.

The great difference between cows' milk and human milk is the fact that human milk is persistently alkaline, whereas cows' milk is usually acid; that there is more nitrogenous material in cows' milk; that there is a much smaller percentage of milk-sugar in cows' milk, and, finally, that the nitrogenous constituents of the milk of the cow are affected by rennet in a manner different from those of mothers' milk.

In order, therefore, to feed cows' milk to infants, these differences must be corrected, and the correction

of them causes further differences, which have, in turn, also to be corrected; the process, therefore, is a complicated one.

Before considering the means adopted to alter the chemical composition of cows' milk, it would be proper to state that there is a common, but false, belief that milk from one cow is the best for infants' use. The principle that underlies this belief is perfectly right. It is, that it is desirable to obtain milk of uniform composition; but it has been found experimentally that milk of the same cow varies in its composition during twenty-four hours, and that it is, in reality, more likely that a mixture of the milk from several cows will show a more constant analytical result than that from one single animal. Jacobi and others have stated that the chances of infection from tuberculosis through the medium of milk can only be lessened by feeding from a large number of cows.

In order to render the character of cows' milk similar to that of human milk, it is necessary to reduce the amount of casein in cows' milk. This is usually done by treating the milk with water, thus diluting it; but sometimes lime-water is used, for the reason to be stated immediately.

Second, the proportion of fat in cows' milk is less than in human milk, and it has been still further reduced by dilution. Therefore, it is necessary to add to it fat in some form or other, and this is commonly done by adding cream.

Thirdly, sugar must be added to cows' milk in order to bring the lactose up to the proper level. It has been held by some that it is necessary to use milk-sugar for this purpose, but there seems to be little doubt that cane-sugar will serve the purpose quite well, or even better.

Fig. 48.—Athrepsia Infantum.

In the fourth place, according to Jacobi, it is necessary to prevent as far as possible the great coagulating effect that the ferment of the infants' gastric juice has on the casein of cows' milk, and this is satisfactorily accomplished by adding an alkali, such as lime-water, or some mucilaginous material, such as barley-water. In this way the casein curd is rendered loose and flocculent and more like that of human milk.

Dr. Meigs, of Philadelphia, advises the preparation of the following mixture: Cream, 2 ounces; milk, 1 ounce; lime-water, 2 ounces; sugar-water, 3 ounces; the latter is made by dissolving about 2 $^1/_4$ ounces of milk-sugar in a pint of water.

Condensed cows' milk is simply cows' milk that has been evaporated to one-fourth of its volume and sterilized, nothing at all being added to it. Then, again, there is a form in which the milk is not only condensed, but has also the addition made to it of about 50 per cent. of cane-sugar. When it is also borne in mind that the composition of condensed milk varies with the season of the year, great fluctuations must occur in its chemical constitution.

Condensed milk must also be diluted with water before it is fit for use, and this dilution may entirely disarrange the proportion of the component parts of the fluid. For this reason it is found that even where infants appear to thrive on condensed milk, their apparent good health is due to an excessive deposit of fat, and not to a sufficient supply of albuminoids; and they are, in the long run, more prone to disease than babies fed on the breast or on cows' milk properly prepared.

The above remarks apply with less force to that variety of condensed milk which is made from sterilized fluid and then sweetened; but even this preparation re-

quires for digestibility to be diluted some ten times, and this reduces its nutritive value to a dangerous degree.

At times we must resort to various methods of feeding, until we find the method on which a baby will thrive, and so it is that we have: (1) humanized milk, (2) sterilized milk, (3) pasteurized milk, and (4) peptonized milk.

1. Humanized milk is simply cows' milk diluted with a certain amount of whey and with some cream. It is prepared in the following way: A pint of milk is set aside in a cool place until the cream rises to the surface. This is skimmed off and kept, and to the milk remaining is added enough rennet to curdle it thoroughly. The whey is strained off from the curd and added with the cream, previously separated, to a pint of fresh cows' milk, and the mixture is known as humanized milk. It is distinctly more digestible than ordinary diluted milk, and often agrees well with young infants, being given without any further dilution, in quantities suitable to the age of the infant. It may be employed exclusively during the first three months of the infant's life, and after that age may be used in combination with some farinaceous food.

2. Sterilized milk is that in which all germs tending to decompose it have been destroyed by exposure to a boiling heat at a temperature of 212° F. for a short period of time: from 15 to 45 minutes. Fresh cows' milk always contains impurities received from the cow or the atmosphere or from the vessels in which it is contained, though much care may have been taken to maintain absolute cleanliness. The milk is usually exposed to the action of steam or in a boiling heat from 5 to 45 minutes, and will keep about 24 hours. A fresh bottle must always be opened for each meal; if anything is left in the bottle after the baby has finished, it must be thrown out.

3. Pasteurized milk is simply steamed at a temperature of 167° to 170°, for about 30 minutes; in other words, it is really sterilized milk at a lower temperature.

4. Peptonized milk, the fourth substitute for ordinary diluted milk, is as simple a preparation as sterilized milk. It consists of milk which has previously been partially digested by the addition of some preparation of a digestive ferment, among the best known of which are Benger's liquor pancreaticus, Fairchild's peptonizing powders, etc. The milk should be diluted to some extent before being peptonized; but it is not necessary to dilute to such an extent as has been recommended for ordinary cows' milk. Generally, even for an infant two or three days old, the addition of an even quantity of barley-water will be sufficient, and, when a baby is two or three months old, a dilution of 2 parts of milk with 1 part of water will be digested with comfort.

In France there is a law forbidding anyone to give solid food of any kind to infants under a year without the written authority of a qualified medical man.

Jacobi says: "Whatever I have here brought forward is certainly not to disparage the boiling of the milk; it is to prove the danger of relying on a single preventive when the causes of intestinal disorders are so many." It is true, however, that the large majority of the latter depends on causes which may be met by sterilization; but not by sterilization only; also by pasteurization, that is, heating the milk to 70° C. (165° F.), and keeping it at that uniform temperature for 30 minutes: a procedure which destroys the same germs that are killed by a more elevated temperature, without much change in flavor and taste.

One of the questions connected with the employment

of sterilized or pasteurized milk is this: whether the milk to be used for a child ought to be prepared at home, or whether the supply may be procured from an establishment where large quantities of milk believed to become immutable by sterilization for an indefinite period are kept for sale. In regard to this problem Flügge plainly expresses his regrets that "we have allowed ourselves to be guided by people who are neither hygienists nor physicians, but chemists, farmers, or apothecaries, and whose actions have been based on three false beliefs. Of these the first is that boiling for three-quarters of an hour destroys germs; the second that whatever bacteria remain undestroyed are innocuous, and the third, that proliferating bacteria can always be recognized by symptoms of decomposition." Nothing is more erroneous. Soxhlet himself, the German originator of sterilization, knew at an early time that the fermenting process is now and then but partially interrupted by boiling, that butyric acid may be found in place of lactic acid, that a strong evolution of gas may be caused after much boiling, and that such milk may give rise to flatulency. Aye, milk which happens to contain the resistant spores of bacteria becomes a better breeding-ground for them by the very elimination of lactic acid, and the longer such sterilized milk is preserved and offered for sale, the worse is its condition. It may be true that these conditions are not met with very frequently, but an occasional single death in a family caused by poisonous milk will be more than enough. Therefore, the daily home-sterilization is by far preferable to the risky purchase from wholesale manufacturers who cannot guarantee, because, in the nature of things, they cannot know the condition of their wares.

Another alteration of a less dangerous character, but far from being desirable, is the separation of cream from sterilized milk which is preserved for sale. Renk[70] found it to take place to a slight extent during the very first weeks, but later to such a degree that 43.5 per cent. of all the cream contained in the milk was eliminated.

Sterilization has been claimed to be no unmixed boon, because of its changing the chemical constitution of milk. Still, the opinions on that subject vary to a great extent, the occurrence of changes being both asserted and denied by apparently competent judges. But what I have said a hundred times is still true and borne out by facts, viz.: that no matter how beneficial boiling, or sterilization, or pasteurization may be, they cannot transform cows' milk into woman's milk, and that it is a mistake to believe that the former, by mere sterilization, is a full substitute for the latter. It is true, that when we cannot have woman's milk we cannot do without cows' milk. There is no alleged substitute that can be had with equal facility or in sufficient quantity. But after all it is not woman's milk. Babies may not succumb from using it, and may seldom appear to suffer from it; indeed, they will mostly appear to thrive on it, but it is a make-shift after all, and requires modifications. Hammarsten was the first to prove the chemical difference between the casein of cows' and woman's milk. Whatever was known on that subject at that time I collated in Gerhardt's "Handbuch der Kind," vol. i, 1875 (second edition, 1882). But lately Wroblewski demonstrated the difference in solubility of the two milks. Woman's casein retains, during pepsin digestion, its nuclein—proteid rich in phosphorus—in solu-

[70] Archiv für Hygiene, xvii.

tion, which is fully digested; in cows' casein the nuclein is not fully digested,—a "paranuclein" is deposited undissolved and undigested.

Henry A. Bunker, in an article on the modification of cows' milk, says that the difficulty of the digestion of the casein of cows' milk in some children has seemed to be the resistance to the infant's digestive powers, even after the partial hydration supposed to be brought about by hydrochloric acid and heat. In all such cases the fæcal evacuations were white, hard, and dry, such as so often occur on a plain, sterilized-milk diet. In many of these cases, these dry, scybalous masses would frequently set up mucous diarrhœa and give rise to severe colicky pains.

The only evidence of partial hydration by the acid and heat would seem to be the fact of increased nutrition in spite of these difficulties. Professor Chittenden[71] maintains and proves, by a beautiful laboratory-experiment, that the products of gastric digestion have the power of combining with more hydrochloric acid than the original proteid, for, as soon as proteolysis commences, the products so formed begin to show their greater affinity for acid by withdrawing acid from its combination with the native proteid: a supposition which is necessary to account for even the starting of the proteolytic process. Further, it is evident that proteoses and peptones combine with a far larger equivalent of acid than the native proteid-albumin, in the experiment, is capable of. This, doubtless, depends upon the cleavage of the large proteid molecule into a number of smaller or simpler molecules, each of the latter, perhaps, combining with a like number of hydrochloric-acid molecules. However this may be, it is evi-

[71] "Cartwright Lectures on Digestive Proteolysis," 1894.

dent that the products of pepsin-proteolysis combine with a larger amount of hydrochloric acid than the mother-proteid, and that the transformation of the latter, at least under the conditions of the experiment, is a slow and gradual process.

It will be remembered that the original method proposed the hydration of the milk-proteids by hydrochloric acid and a rather prolonged boiling. Twenty drops of a 10-per-cent. hydrochloric-acid solution were added to 1 pint of water and 1 quart of milk, and this mixture was to be kept at boiling temperature for about twenty minutes. The addition of a larger amount of the acid, unless the milk was quite fresh, was found to result quite frequently in curdling the milk. It was also found that the acid so added, up to the point of saturation or breaking, exists as combined acid, as was evident from the failure of reagents to show free hydrochloric acid in the completed mixture.

The indications that the hydration secured by this method is not always sufficient to meet the requirements of certain infantile stomachs and the fact that usually in such cases the nutrition is increased in spite of incomplete and painful digestion, seemed so strongly confirmatory of the results of Professor Chittenden's researches, that I determined to copy, in part, his experiments on HCl saturation, as applied to the proteids of milk.

To this end, milk was prepared in the original way, except that the 20 drops of dilute hydrochloric acid were added in $^1/_2$, instead of 1, pint, watery solution, and slowly, but intimately, mixed with 1 quart of milk. This mixture was brought as rapidly as possible to the boiling temperature and then set aside until another half-pint of water was prepared with 20 drops more of the acid. This

was added to the previously-boiled milk and acid, stirred thoroughly, and again brought to the boiling-point. The result thus obtained was a thoroughly palatable milk, with no taste of having been boiled, and gave no indication of free hydrochloric acid with Gunzberg's reagent. Rudisch's plan is similar to the latter.

Proteids in excess are indicated by the presence of curds in the stools. This is the most frequent cause of colic in infants. Sometimes there is diarrhœa, more often constipation when the proteids are in excess. The excess of proteids frequently causes vomiting and so does an excess of both fat or sugar. If, therefore, after reducing the percentage of proteids, fat, or sugar, vomiting still persists, then we must feed the baby with smaller quantities. Thus, we may have to give a 4-ounce bottle where a 6-ounce or a 5-ounce feeding causes vomiting. Certain rules can be laid down: if an infant does not thrive,—that is, does not gain in weight without showing any signs of indigestion,—then the proportions—*i.e.*, percentages of all ingredients—should be gradually increased; chiefly the proteids, however, for the latter is the most important element in an infant's food.

An infant soon after birth was put on modified milk, containing:—

Fat	2.00
Milk-sugar	5.00
Albuminoids	0.75
Lime-water	1/16

I ordered eight feedings, 2 ounces in each. As the child was constipated, soon after we increased the formula to the following percentages:—

Fat	2.50
Milk-sugar	6.00
Albuminoids	1.00
Lime-water	$^{1}/_{16}$

As the stools did not change, the fat was increased to 3 per cent., other ingredients the same. The child gained but 3 ounces in weight in five weeks; had greenish, curded stools, and had distinct evidence of intestinal indigestion. It also vomited curds. The general condition of the child was one of extreme irritability, with very little sleep. Hand-feeding was stopped. The child's alimentary tract was thoroughly cleaned, and a wet-nurse secured. This was when the baby was six weeks old; the child nursed well, gained 6 ounces the first week, 8 ounces the second, and weighed 14 pounds when it was four and a half months old. The child improved until it was seven months old, when suddenly the weight remained stationary. A specimen of breast-milk was sent to John S. Adriance, the chemist of the Nursery and Child's Hospital, who found the following percentages:—

Fat	2.000
Sugar	7.431
Proteids	0.882
Ash	0.162

Specific gravity, 1031; reaction, alkaline.

It is very evident that the deficiency in albuminoids or proteids is accountable for the stationary weight. The child did not gain an ounce in one month. We discharged the wet-nurse, and resorted to hand-feeding, when the child's general condition changed, and she is bright and well to-day.

In another instance, a child had been nursed by its own mother for three months, and had gained in weight

regularly at the rate of 6 and 7 ounces per week; the stools were normal in quantity and quality, when suddenly the child appeared to be colicky, was restless at night, had green stools, and did not appear to thrive. For two consecutive weeks the child did not gain in weight, and a specimen of breast-milk was sent to the Pediatrics Laboratory. Mr. R. W. Bailey, the chemist, examined the specimen, with the following result:—

Fat	2.43
Proteids	1.25
Sugar	6.51
Ash	0.20
Total solids	10.39

Specific gravity, 1027; reaction, slightly alkaline.

The percentage of fat and proteids is so low that it was very plain to me why this child did not increase in weight. On putting the child on an oatmeal and top-milk mixture, the digestion improved, the child's sleep was better, and the weight increased.

Another case was that of a nursling, brought to me with a history of excessive crying, greenish stools, cheesy curd in the stools, vomiting, restlessness, and a general condition of malassimilation; I asked for a specimen of breast-milk, which Mr. Bailey kindly examined, with the following result:—

Fat	4.32
Sugar	6.22
Proteids	1.80
Ash	0.19
Total solids	12.53

Reaction, neutral.

The general history of the case showed that the child was fed every time it cried, and thus it was evident that overfeeding was the real cause of the trouble in this case, for I learned that the child frequently nursed for hours at the breast, and was also allowed to go to sleep with the nipple in its mouth. Whenever the child cried it was fed, frequently as often as every half-hour, so that in this case, while the quality of the breast-milk was absolutely normal, as demonstrated by the chemical examination, it required only the judicious interval for feeding to give the child's stomach proper time for the assimilation of its food.

CHAPTER XLII.

General Rules for Rectal Feeding.

In another chapter entitled "Rectal Feeding in Diphtheria" attention has already been given to the method

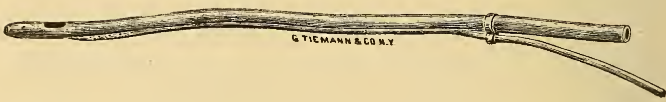

Fig. 49.—Author's Double-Current Rectal Tube for Flushing the Colon and Rectum and Used for Rectal Feeding.

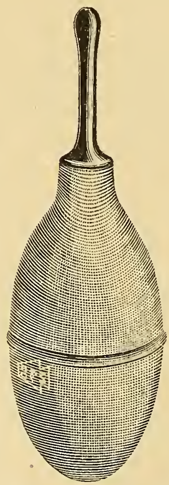

Fig. 50.—Rectal Syringe.

of cleansing the rectum, and also to the injection of foods. The same rules are applicable when there is excessive

irritability of the stomach with constant vomiting and where it is desirable to give the stomach absolute rest.

Fig. 51.—Rectal Syringe.

Small quantities properly injected will be retained and absorbed much easier than large quantities of food, which will merely serve as irritants and be expelled.

CHAPTER XLIII.

Nasal Feeding.

Nasal feeding has long been in use where diseases of the mouth or spasm of the jaw or intubation in diphtheria rendered swallowing difficult. A thin rubber catheter is

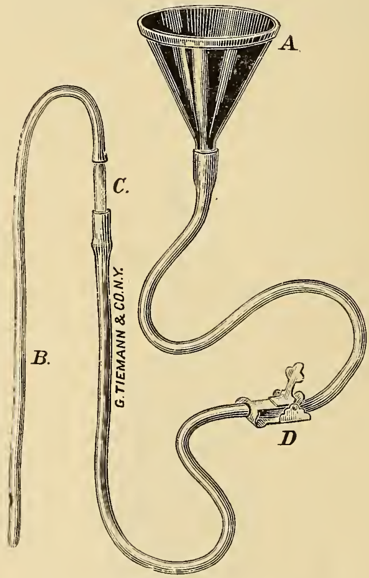

Fig. 52.—Author's Apparatus for Irrigating Rectum and well Adapted for Stomach-washing (Lavage) and also for Forced Feeding (So-Called Gavage). Also Useful in Nasal Feeding.

attached to a long rubber tube ending in a funnel, which is the same apparatus as has been already described on

page 244 in the chapter on "Stomach-washing and Gavage."

Modus Operandi.—Lay the child flat on its back and have a large sheet pinned over the body, so that the hands are firmly held; have the feeding-mixture all prepared, so that no time will be lost. A soft-rubber catheter, lubricated with vaselin or glycerin, is gently pushed into the nostril and glided through the pharynx into the œsophagus and stomach. When the tube is in the stomach, pour the required amount of food into the funnel so that it flows in the stomach. When the proper amount has been used, withdraw the catheter from the nose, and boil it in warm water to properly sterilize it for the next feeding.

Quantity of Food.—The quantity of food used in nasal feeding should be somewhat less than is ordinarily used in health. It is understood that only liquid foods —like peptonized milk, sterilized milk, soups, broths, or bouillon—can be used for feeding in this manner. A thin emulsion of egg can also be used. Owing to the frequency of both nausea and vomiting, which may be induced by irritation of the fauces, while the tube is gliding through the pharynx into the œsophagus, a much larger interval must be given between the feedings. It is desirable to introduce the tube rapidly and remove it rapidly if it is at all possible. Accidents will result in nasal feeding if a large quantity of liquid food is regurgitated through the œsophagus into the mouth and aspirated through the larynx into the trachea. Many a case of "*Schluck-pneumonie*" can be traced to accidents of this kind.

DIETARY.

Almond-milk.

Take 2 ounces of sweet almonds, scald them with boiling water; after a few moments express them from the hulls; then pour the hot water away. Put the blanched almonds into a mortar and pound them thoroughly, and add either 2 ounces of milk or 2 ounces of plain water. After this is thoroughly mixed, it is to be strained through cheese-cloth, and the strained liquid will be the almond-milk.

Keller's Malt-soup.

Take of wheat-flour 50.0 (about 2 ounces). To this and 11 ounces of milk. Soak the wheat-flour thoroughly, and rub it through a sieve or strainer.

Put into a second dish 20 ounces of water, to which add 3 ounces of malt-extract; dissolve the above at a temperature of about 120° F., and then add 10 cubic centimetres (about 2 $^1/_2$ drachms) of 11-per-cent. kali-carbonic solution. Finally mix all of the above ingredients, and boil.

This gives a food containing:—

Albuminoids	2.0 per cent.
Fat	1.2 per cent.
Carbohydrates	12.1 per cent.

There are in this mixture:—

Vegetable proteids	0.9 per cent.

The wheat-flour is necessary, as otherwise the malt-soup would have a diarrhœal tendency. The alkali is

added to neutralize the large amount of acid generated in sick children. Biedert emphasizes the importance of giving fat, rather than reducing its quantity, in poorly-nourished children, and cites the assimilability of his cream-mixture or of breast-milk in under-fed children as proof of his assertions. The author has used this malt-soup most successfully in the treatment of athrepsia (marasmus) cases in which the children were simply starved.

Junket of Milk and Egg.

Beat 1 egg to a froth and sweeten with 2 teaspoonfuls of white sugar. Add this to 1/2 pint of warm milk; then add 1 teaspoonful of essence of pepsin (Fairchild); let it stand till it is curdled. The above is useful in typhoid and similar wasting diseases.

Plain Junket.—This is sometimes called "curds and whey." Take 1/2 pint of fresh, raw milk, and heat it lukewarm. Then add a teaspoonful of Fairchild's essence of pepsin, and stir the mixture thoroughly. Pour into custard cups, and let it stand until firmly curdled. The flavor can be improved by adding some essence of lemon or cinnamon or grated nutmeg.

When the essence of pepsin (Fairchild's) cannot be had, or for convenience in traveling, the author has used Hansen's junket tablets, which will give similar results as with the liquid essence of pepsin.

Peptogenic Milk-powder.

The pancreas ferment trypsin is known to have a remarkable affinity toward milk, digesting its casein with great rapidity without altering its other elements, and without rendering the milk repulsive. When milk is so

treated it is known as peptonized milk. Through the expert investigation of the well-known chemist, Dr. Albert Leeds, the peptogenic milk-powder was found to yield a milk which was similar to a humanized milk. The author has had some experience in the modification of cows' milk by the addition of peptogenic milk-powder, and can safely say that it is one of the most valuable additions to our infant-feeding that we possess.

There are three steps necessary for the preparation of "humanized milk" in using the peptogenic milk-powder:—

1. To prepare—with peptogenic powder, cows' milk, water, and cream—a mixture which has the *quantitative* composition of average human normal milk.

2. To subject this mixture to the *action of the digestive principle* by which the albuminoids (casein, etc.) are converted into such form as to become identical with those of human milk.

3. To then *destroy the digestive ferment* by simply raising the temperature of the milk to the boiling-point. This heat also destroys the bacteria, and renders the milk practically sterile during the time required for its use: twenty-four hours.

DIRECTIONS FOR "HUMANIZED MILK."

No. 1.—For the daily food of a healthy infant: Put into a clean graniteware or porcelain-lined saucepan one measure (which accompanies each bottle) of peptogenic powder; add to this $^1/_2$ pint of cold water, $^1/_2$ pint of cold, fresh milk, and 4 tablespoonfuls of cream. Place the saucepan on a hot range or gas-stove, and heat, with constant stirring, until the mixture boils. *The heat should be so applied as to make the milk boil in ten minutes.* Keep

in a clean, well-corked bottle, in a cool place. When needed, shake the bottle, and pour out the desired portion, and warm the same before feeding.

No. 2.—Specially designed for children with feeble digestion, or when the stomach and bowels are disordered, as in catarrhal conditions. Put into a clean bottle 1 measure of the peptogenic powder, $^1/_2$ pint of cold water, $^1/_2$ pint of cold, fresh milk, and 4 tablespoonfuls of cream. Shake well, place the bottle in a pail or tin kettle of water, holding a gallon, as hot as can be borne by the hand (115° F.), and keep the bottle there for thirty minutes. Then pour all into a saucepan, and *quickly* heat to boiling-point, with constant stirring. The bottles of the peptogenic milk-powder made by Fairchild Brothers & Foster have a metal screw-cap, which is the measure above alluded to. If the infant's digestive powers are still weaker, or if, after feeding the last-named formulæ, vomiting takes place, then it is safer to use:—

One measure of peptogenic milk-powder.
One-third pint of raw milk.
Two-thirds pint of water.

Mix, heat, and boil, as described above, and it is advisable to feed at longer intervals; for example, every three or four hours, if the infant has previously been fed every two or three hours. Never use the balance left over in a feeding-bottle, after the infant has sucked, but always give a fresh quantity of food for each meal, and whatever the baby leaves should be invariably thrown away.

The weight and the stools are important factors in judging when to increase the quantity of milk and cream, or *vice versâ.*

Peptonized Milk.

Into a clean, quart bottle put the powder contained in one of the Fairchild peptonizing tubes, and a teacupful (gill) of cold water; shake, then add a pint of fresh, cold milk, and shake the mixture again. Place the bottle in water so hot that the whole hand can be held in it without discomfort. (About 115° F.)

Keep the bottle there five or ten minutes as directed.

At the end of that time put the bottle on ice *at once* to check further digestion and keep the milk from spoiling.

Place the bottle directly in contact with the ice.

The degree of digestion is very simply regulated by the length of *time* in which the milk is kept warm.

PARTIALLY PEPTONIZED MILK.

Put into a clean agateware or porcelain-lined saucepan the powder contained in one of the Fairchild peptonizing tubes, and a teacupful (gill) of cold water; stir well; then add a pint of cold, fresh milk. Heat with constant stirring until the mixture boils. The heat should be so applied that the milk will come to a boil in ten minutes. When cool, strain into a clean bottle, cork well, and keep in a cold place. When needed, shake the bottle, pour out the required portion, and serve cold or hot, as directed by the physician in charge. Milk so prepared will not become bitter.

IMMEDIATE PROCESS.

Put 2 tablespoonfuls (1 ounce) of cold water in a goblet or glass; dissolve in this one-quarter the contents of a peptonizing tube; add 8 tablespoonfuls (4 ounces) of warm milk; drink immediately, sipping slowly.

If half a pint of milk is required, double the proportions of water, peptonizing powder, and milk.

COLD PROCESS.

Into a clean, quart bottle put the powder contained in 1 of the Fairchild peptonizing tubes, and a teacupful (gill) of cold water; shake, then add a pint of fresh, cold milk; shake the mixture again and immediately place the bottle on ice, without subjecting it to the water-bath or any heat. Place the bottle directly in contact with the ice.

When needed, shake the bottle, pour out the required portion, and use in the same manner as ordinary milk.

Peptonized Milk-gruel.

Thick, well-boiled, hot gruel	$^1/_2$ pint.
Milk, fresh, cold	$^1/_2$ pint.

Mix and *strain* into a small pitcher or jar, and immediately add the contents of 1 Fairchild peptonizing tube: mix well. Let it stand in the hot water-bath, or warm place, for five minutes, then put in a clean bottle and place on ice. Serve hot or cold.

Gruel made from arrowroot, flour, barley, oatmeal, etc., will serve for the purpose. In each instance the farinaceous material should be boiled with water until the starch-granules have been thoroughly swollen, broken up, and incorporated with the water.

Junket (Curds and Whey).

Junket.—Take $^1/_2$ pint of fresh milk, heated lukewarm—not warmer than can be agreeably borne by the mouth (about 115° F.); add 1 teaspoonful of Fairchild's essence of pepsin, and stir just enough to mix. Pour into

custard-cups; let it stand until firmly curdled; may be served plain or with sugar and grated nutmeg.

An egg beaten to a froth and sweetened with 2 teaspoonfuls of sugar may previously be added to the half-pint of milk, forming a highly nutritious and smooth jelly. The essence will curdle milk with egg as readily as plain milk.

Whey.—Curdle warm milk with the essence of pepsin as above directed; then beat up with a fork until the curd is finely divided; now strain, and the whey is ready for use.

Whey is a highly-nutritious fluid food peculiarly useful in many ailments and always valuable as a means of variety in diet for the sick. It is frequently resorted to as a food for infants to tide over periods of indigestion, summer complaints, etc.

Gum-Arabic Water.

Dissolve 1 ounce of gum arabic in a pint of boiling water; add 2 tablespoonfuls of sugar, a wineglassful of sherry, and the juice of a large lemon. Cool and add ice.

Lime-water.

Pour 2 quarts of water over fresh unslaked lime the size of a walnut; stir until slaked, and let stand until clear; then bottle. Lime-water is often ordered with milk to neutralize acidity of the stomach.

Tamarind-water.

A very refreshing drink may be made by adding 1 pint of hot water to 1 tablespoonful of preserved tamarinds, and setting aside to cool.

Lemonade.

Squeeze the juice from 1 lemon. Add 2 tablespoonfuls of sugar and 1 cup of water. Strain and serve.

Milk and Albumin.

Put into a clean quart bottle 1 pint of milk, the whites of 2 eggs, and a small pinch of salt. Cork and shake hard for five minutes.

Milk-punch.

Take $^1/_2$ pint of fresh, cold milk and add 2 teaspoonfuls of sugar, and stir well until dissolved; then add 1 ounce of either brandy or sherry-wine.

Orangeade.

Substitute orange-juice for that of lemon in the recipe for "Lemonade."

Tea.

Scald out the teapot and put in the tea, using 1 teaspoonful for 1 cupful. Pour on *boiling* water, and let teapot stand four or five minutes. If allowed to stand too long, the tannin in the tea is developed, which not only darkens the tea, but also renders it hurtful.

Albumin-water.

Stir the whites of 2 eggs into $^1/_2$ pint of ice-water, without beating; add enough salt or sugar to make it palatable.

Apple-water.

Slice into a pitcher $^1/_2$ dozen juicy sour applies; add 1 tablespoonful of sugar, and pour over them 1 quart of boiling water. Cover closely until cold; then strain.

Barley-water.

Wash 2 ounces (wineglassful) of pearl barley with cold water. Boil it five minutes in fresh water; throw both waters away. Pour on 2 quarts of boiling water; boil down to 1 quart. Flavor with thinly-cut lemon-rind; add sugar to taste. Do not strain unless at the patient's request.

Cocoa.

Allow 1 teaspoonful of cocoa for each cup; add sufficient hot water to form a paste; pour on boiling milk (or milk and water) and sweeten to taste; five minutes' boiling will improve the cocoa.

Coffee (French).

Some persons prefer filtered to boiled coffee. Filtered coffee is best made in a French biggin, consisting of two tin vessels, one fitting into the other, the upper one being supplied with strainers. The coffee, being very finely ground, is placed in this utensil, and the boiling water allowed to slowly percolate through it. The pot should be set where it will keep hot, but not boil, until the water has gone through. Pouring it through the coffee a second time will make it stronger, but it loses in flavor. *Café noir* is always made in this way.

Nutritious Coffee.

Dissolve a little isinglass or gelatin (Knox) in water; put $^1/_2$ ounce of freshly-ground coffee into a saucepan with 1 pint of new milk, which should be nearly boiling before the coffee is added; boil both together for three minutes; clear it by pouring some of it into a cup and dashing it back again; add the isinglass, and leave the

coffee on the back part of the range for a few minutes to settle. Beat up 1 egg in a breakfastcup, and upon it pour the coffee; if preferred, drink without the egg.

Eggnog.

Scald some milk by putting it, contained in a jug, into a saucepan of boiling water, *but do not allow the milk to boil.* When cold, beat up a fresh egg with a fork in a tumbler with some sugar; beat to a froth, add a dessert-spoonful of brandy, and fill up tumbler with the scalded milk.

Soft Custard.

Take of corn-starch 2 tablespoonfuls to 1 quart of milk; mix the corn-starch with a small quantity of the milk, and flavor; beat up 2 eggs. Heat the remainder of the milk to near boiling; then add the mixed corn, the eggs, 4 tablespoonfuls of sugar, a little butter, and salt. Boil the custard two minutes, stirring briskly.

Calf's-Foot Jelly.

Thoroughly clean 2 feet of a calf, cut into pieces, and stew in 2 quarts of water until reduced to 1 quart; when cold, take off the fat and separate the jelly from the sediment. Then put the jelly into a saucepan, with white wine and brandy and flavoring to taste, with the shells and whites of 4 eggs well mixed together; boil for a quarter of an hour, cover it, and let it stand for a short time, and strain while hot through a flannel bag into a mold.

Tapioca-cream.

Take 1 pint of milk, 2 tablespoonfuls of tapioca, 2 tablespoonfuls of sugar, 1 saltspoonful of salt, and 2 eggs. Wash the tapioca. Add enough water to cover it, and let

it stand in a warm place until the tapioca has absorbed the water. Then add the milk and cook in a double boiler, stirring often until the tapioca is clear and transparent. Beat the yolks of the eggs. Add the sugar and salt and the hot milk. Cook until it thickens. Remove from the fire. Add the whites of the eggs, beaten stiff. When cold, add 1 teaspoonful of vanilla.

Chocolate.

Take 2 squares of vanilla chocolate to each coffeecupful of milk. Grate the chocolate and wet it with cold milk and stir into the milk when it boils. Whip a tablespoonful of cream, and beat it into the chocolate just as it is taken from the fire. This makes one cup of rich, delicious chocolate. Do not let it boil, as it becomes oily and loses its fine, fresh flavor.

Toasted Bread (Toast Dry).

Cut thin slices of bread into strips, toast carefully and evenly without breaking, slightly butter, and serve immediately on a hot plate.

Cream-toast.

Take 1 cupful of cream, 1 saltspoonful of salt, 2 slices of dry toast, or make the same as milk-toast, using cream in place of the milk. If preferred, the slices of toast may be first dipped in hot, salted water.

Egg-toast.

Take 1 egg, 1 saltspoonful of salt, 1 cupful of milk, 6 slices of bread. Beat the egg lightly; add the salt and milk. Soak slices of bread in this until soft. Butter a hot griddle, put on the bread; when one side is brown,

put a bit of butter on each slice, then turn and brown the other side. Serve with sugar and cinnamon.

Milk-toast.

Take 1 cupful of milk, $^1/_2$ tablespoonful of corn-starch, $^1/_2$ tablespoonful of butter, 2 slices of dry toast, 1 saltspoonful of salt. Scald the milk. Melt the butter in a saucepan; when hot and bubbling, add the corn-starch. Pour in the hot milk slowly, beating all the time until smooth. Let it boil up once. Then add the salt. Toast 2 slices of bread. Pour the thickened milk over the slices. Let it stand five minutes. Serve.

Baked Apples.

Core and pare 2 tart apples; fill the core-holes with sugar; grate over the apples a little nutmeg; add a little water to baking-pan and put in oven and bake until the apples are soft. Serve with rich milk or cream. Sprinkle with icing sugar, if not sweet enough.

Mutton-soup.

Cut up fine 2 pounds of lean mutton, without fat or skin. Add 1 tablespoonful of barley, 1 quart of cold water, and a teaspoonful of salt. Let it boil slowly for two hours. If rice is used in place of barley, it will not need be put in until half an hour before the soup is done.

White-Celery Soup.

Take $^1/_2$ pint of strong beef-tea; add an equal quantity of boiled milk, slightly and evenly thickened with flour. Flavor with celery-seeds or pieces of celery, which are to be strained out before serving. Salt to taste.

Scrambled Eggs.

Take 4 eggs, $^1/_2$ teaspoonful of salt, 1 saltspoonful of pepper, $^1/_4$ cup of milk, and 1 tablespoonful of butter. Beat the eggs lightly; add the salt, pepper, and milk. Put the butter into a saucepan; when melted and hot, add the eggs. Stir over hot water until of a soft, creamy consistency. Serve on buttered toast.

Soft-Boiled Eggs.

Drop 2 eggs into enough boiling water to cover them. Let them stand on the back of stove, where the water will keep hot, but not boil, for eight minutes. An egg to be properly cooked should never be boiled in boiling water, as the white hardens unevenly before the yolk is cooked. The yolk and white should be of a jelly-like consistency.

Infant's Food.

About 1 teaspoonful of gelatin should be dissolved by boiling in $^1/_2$ pint of water. Toward the end of the boiling 1 gill of cows' milk and 1 teaspoonful of arrowroot (made into a paste with cold water) are to be stirred into the solution, and 1 to 2 tablespoonfuls of cream added just at the termination of the cooking. It is then to be moderately sweetened with white sugar, when it is ready for use. The whole preparation should occupy about fifteen minutes.

Custard Pudding.

Break 1 egg into a teacup, and mix thoroughly with sugar to taste; then add milk to nearly fill the cup, mix again, and tie over the cup a small piece of linen; place the cup in a shallow saucepan half-full of water and boil for ten minutes.

If it is desired to make a light batter pudding, a teaspoonful of flour should be mixed in with the milk before tying up the cup.

Corn-flour Pudding.

Take 1 pint of milk, and mix with it 2 tablespoonfuls of flour; flavor to taste; then boil the whole eight minutes; allow it to cool in a mold, and serve up with or without jam.

Rice Pudding.

Take 1 teacupful of rice; wash, and pour over it boiling water, and let stand five minutes; then drain off the water and add a cupful of sugar to the rice, a little nutmeg, 2 quarts of milk, and 1 egg. Bake slowly about two hours, stirring occasionally until the last half-hour, then brown.

Sago Pudding.

Same as above recipe, sago being substituted for rice.

Snow Pudding.

Dissolve $^1/_2$ box of gelatin in 1 pint of cold water; when soft, add 1 pint of boiling water, the grated rind and juice of 2 lemons, and 2 $^1/_2$ cupfuls of sugar. Let the gelatinized water stand until cold and beginning to stiffen. Then beat in the well-beaten whites of 5 eggs. Pour into a mold and set on ice. Serve with custard sauce: 1 quart of rich milk, the yolks of 5 eggs, and 2 extra eggs added, and $^1/_2$ cupful of sugar. Flavor with vanilla.

Peptonized Oysters.

Mince 6 large or 12 small oysters; add to them, in their own liquor, 5 grains of extract of pancreas with 15 grains of sodium bicarbonate (or 1 Fairchild peptonizing

tube). This mixture is then brought to blood-heat (98° F.), and maintained, with occasional stirring, at that temperature thirty minutes, when 1 pint of milk is added and the temperature kept up from ten to twenty minutes. Finally, the mass is brought to the boiling-point, strained, and served. Gelatin may be added, and the mixture served cold as a jelly. Cooked tomato, onion, celery, or other flavoring suited to individual taste may be added at beginning of the artificial digestion.

Oyster-stew.

Take 1 pint of oysters, 1 pint of milk, 1 teaspoonful of salt, $^1/_4$ cupful of water, 1 tablespoonful of butter, and 1 saltspoonful of pepper. Scald the milk. Wash the oysters by adding the water, and remove all shells. Drain, saving the liquor. Put the liquor into a stewpan and heat slowly. Skim carefully. When clear, add the oysters and cook slowly until the edges curl and they are plump. Add the hot milk, butter, salt, and pepper, and serve. Do not let the oysters boil, as that toughens them and renders them indigestible.

Oyster-broth.

Cut into small pieces 1 pint of small oysters; put them into $^1/_2$ pint of cold water, and let them simmer gently for ten minutes over a slow fire. Skim, strain, and add salt and pepper.

Arrowroot Pudding.

Add the yolks of 2 eggs to the plain arrowroot recipe (following), with 1 teaspoonful of powdered white sugar; mix well and bake in a lightly-buttered dish for ten or fifteen minutes.

Arrowroot.

Mix 1 teaspoonful of Bermuda arrowroot with 4 teaspoonfuls of cold milk. Stir it slowly into $^1/_2$ pint of boiling milk, and let it simmer for five minutes. It must be stirred all the time, to prevent lumps and to keep it from burning. Add $^1/_2$ teaspoonful of sugar and a pinch of salt, and, if desired, 1 of cinnamon. In place of the cinnamon $^1/_2$ teaspoonful of brandy may be used or a dozen large raisins may be boiled in the milk. If the raisins are preferred, they should be stoned and the sugar may be omitted.

Oatmeal-gruel.

Pound $^1/_2$ cup of coarse oatmeal until it is mealy. Put it in a tumbler, and fill the tumbler with cold water. Stir well; let it settle; then pour off the mealy water into a saucepan. Fill again and pour off the water, and again repeat this, being careful each time not to disturb the sediment in the bottom of the tumbler. Boil the water twenty minutes. Season with salt. Thin with a little cream or milk. Strain and serve hot.

Chicken-broth.

Skin and chop up a small chicken or half a large fowl; put, bones and all,—with a blade of mace, a sprig of parsley, 1 tablespoonful of rice, and a crust of bread,—in a quart of water and boil for an hour, skimming it from time to time. Strain through a coarse colander.

Clam-broth.

Wash thoroughly 6 large clams in the shell; put them into a kettle with 1 cupful of water; bring to boil, and keep it boiling one minute; the shells open, the water

takes up the proper quantity of juice, and the broth is ready to pour off and serve hot. Add a teaspoonful of finely-pulverized cracker-crumbs, a little butter, and salt to taste.

Rice-water.

One ounce of well-washed Carolina rice. Macerate for three hours at a gentle heat in a quart of water, and then boil slowly for an hour and strain. It may be sweetened and flavored with a little lemon-peel. Useful in diarrhœa, etc., when the flavoring is best dispensed with, and a little old cognac added.

Barley-water.

Take a tablespoonful of pearl barley, grind it in a coffee-grinder, or pound it in an ordinary mortar; add 1 pint of cold water, and allow it to simmer slowly for about an hour. Strain and add enough water to make 1 pint.

Oatmeal-water.

Take a tablespoonful of ordinary oatmeal, and add 1 pint of water. Allow it to simmer slowly for one hour and strain. Add enough water to make 1 pint. The same directions apply to making a household mixture of farina-water, rice-water, and sago-water, using the same proportions as above.

Arrowroot-water.

Add 2 tablespoonfuls of arrowroot to 1 pint of water; allow it to simmer for half an hour, stirring it constantly.

Egg-water.

This is made by mixing thoroughly the white of 1 egg with 6 ounces of water and adding a little salt. The

addition of a few grains of sugar will make the child take it better, and adds also a food-element.

Such a mixture is one of the best foods we have for temporarily feeding an infant with digestive disturbances when we wish, for a time, to stop temporarily all milk-food.

Artificial Milk.

One ounce of suet cut up very finely, and tied loosely in a muslin bag. Boil slowly for an hour in thin barley-water, with $^1/_4$ ounce of isinglass and a little sugar of milk, adding a little water occasionally as it boils away. Pound up 12 sweet almonds, pour the fluid slowly on them, and incorporate well. Strain before using.

Milk Thickened.

A great deal of nourishment can be given in milk by thickening it with either wheat-flour, rice-flour, isinglass, or gum arabic. The method of doing so is this: with

Wheat-flour.—Rub a large spoonful of flour quite smooth, in a few spoonfuls of cold milk. Then add more milk by degrees till you have $^1/_2$ pint. Sweeten and flavor with a little cinnamon, and then boil up the milk, stirring it all the time to prevent its getting lumpy.

Rice-flour is done in exactly the same way.

To thicken milk with isinglass, boil $^1/_2$ ounce of it in a pint of new milk, after sweetening and flavoring it. When boiling, strain it off. A little less isinglass will do, unless the milk is desired very thick.

For thickening with gum arabic the proportions will vary according as the milk is wanted more or less thick. If powdered gum arabic is used, it is done in the same way as flour; but if lumps, drop them into hot milk, until

it is of the desired thickness, and then boil. There is much nourishment in this hot, and it is very soothing where either chest or stomach are in an irritable state.

Rice-milk.

Three tablespoonfuls of rice, 1 quart of milk; wash the rice and put into a saucepan with the milk; simmer until the rice is tender, stirring now and then, and sweeten. Tapioca, semolina, vermicelli, and macaroni may be similarly treated.

Humanized Milk.

A pint of milk is set aside until the cream rises, and this cream is skimmed off and kept. To the milk remaining is added enough rennet to curdle it. The whey is strained off the curd and added with the previously-separated cream to a pint of fresh cows' milk. This is known as humanized milk. In some infants it will be well borne during the first three months, and to this can be added farinaceous liquid for dilution if required.

Pasteurized Milk.

This is really partially sterilized milk, and consists of sterilization at a temperature of 167° F. instead of 212° F. This sterilization to be continued for from twenty minutes to half an hour. Pasteurized milk should only be used during the twenty-four hours following this process. A good apparatus for this purpose is the one known as Dr. Freeman's pasteurizing apparatus.

Peptonized Milk.

This is milk in which the proteids are changed to peptones, or, in other words, digested, by the addition and action of pancreatic ferment. This process may be

stopped when partially performed, giving a product of which the taste is not objectionable; or may be carried on to complete peptonization, when the product has a very bitter, disagreeable taste.

Method.—To peptonize milk partially, add to 1 pint of fresh cows' milk and 4 ounces of water 5 grains of pancreatic extract and 15 grains of bicarbonate of soda. Allow this to stand at a temperature of 105° to 115° F. for five to twenty minutes, then bring to a boil to kill the ferment, or stand on ice to prevent its further action. If the milk is to be used at once, neither of these latter is necessary.

To peptonize the milk completely, allow the process to continue for one to two hours. After this time the addition of acid produces no coagulation.

In infant-feeding it is better to peptonize a modified than a whole milk. Peptonized milk is frequently very useful in feeding an infant with feeble digestive powers; but it is unwise to continue its use over too long a period, as then the infant's stomach, being called on to do no work, becomes enfeebled from disuse, and gradually unable to perform its proper function.

Whey.—By coagulating 1 pint of fresh milk by adding a teaspoonful of essence of pepsin, and allowing this to stand, a solid curd is formed swimming in a liquid (whey). This has the following composition: Proteids, 0.86 per cent.; fat, 0.32 per cent.; sugar, 4.79 per cent.; salts, 0.65 per cent.; water, 93.38 per cent.

This at times makes a very valuable food for infants in cases of gastric or intestinal disorder, where the use of milk must for a time be interdicted. Babies like it, it is very easy of digestion, and does not irritate the stomach. A little wine may be added if desired.

Scraped Beef.

This is another valuable and easily digested food. It is prepared by scraping with a dull knife some raw or rarely-done lean beef. A tablespoonful of this salted is the amount usually given at a feeding.

Beef-tea in Haste.

Scrape 1 pound of lean beef into fibres on a board. Place the scraped meat in a delicately-clean white-lined saucepan and pour $^1/_2$ pint of boiling water upon it. Cover closely and set by the side of the fire for ten minutes; strain into a teacup, place the teacup in a basin of ice-cold water; then remove all fat from the surface, pour into a warm cup, warm this gently with hot water or otherwise, and serve. This can be ready in fifteen minutes, and double the quantity of meat can be used if necessary. Bread and blotting-paper are ineffectual to remove all the fat. A tomato makes excellent flavoring, and other flavors can be added if desired. For children, however, the simpler aliments are the better.

Beef-and-Chicken Broth.

One pound of good lean beef and a chicken boned should be pounded together in a mortar, and a little salt added, and the whole placed in a saucepan with nearly 3 pints of cold water. Stir over the fire until it boils, then boil half an hour, strain through a coarse sieve, and serve.

Liebig's Extract of Beef Thickened.

A teaspoonful of Liebig's extract may be added to a pint of boiling barley-water, with a little salt, or to this may be again added a teacupful of milk, or, instead of the milk, the white of 2 eggs beaten up with 2 tablespoon-

fuls of milk may be stirred into the Liebig beef-tea and barley-water when cool enough to be taken. Too great heat will coagulate the albumin.

Chicken-, Veal-, and Mutton- broths.

The fleshy part of the knuckle of veal; a chicken, bones and all chopped up; or 2 pounds of the scrag end of neck of mutton, added to 2 pints of water, with a little pepper and salt, and boiled two hours and strained, all make excellent broths. Pearl barley, rice, or vermicelli, boiled separately till quite soft, may be added when either of the broths is heated for use. All fat must always be carefully removed by skimming when cold.

Beef-juice.

Expressed beef-juice is obtained by slightly broiling a piece of lean beef, and then squeezing the juice from it by a lemon-squeezer. One pound of steak yields 2 or 3 ounces of juice. This is flavored with salt and given cold or warm. Do not heat enough to coagulate the albumin. This is very nutritious and usually well taken. It may be given at the rate of a tablespoonful three times a day.

Good, Nutritious Beef-tea.

Mince 1 pound of good beef (from which all skin, fat, etc., has been carefully removed) and pour upon it in an earthen jar 1 pint of cold water. Stir, and let it stand for one hour. Then place the jar in a moderate oven for one hour, or stand the jar in a saucepan of water and allow the water to boil gently for an hour. To be exact, the heat to which the beef-tea is raised should not exceed 180° F. Strain through a coarse sieve and allow it to

grow cold. When wanted, remove every particle of fat from the top; warm up as much as may be required, adding a little salt. Beef-tea should, except in the hottest weather, be made a day before it is wanted.

Essence of Beef (with Heat).

One pound of gravy-beef free from skin and fat, chop as fine as mincemeat, pound in a mortar with 3 tablespoonfuls of soft water, and soak for two hours. Then put in a covered earthen jar with a little salt, cement the edges of the cover with pudding paste, and tie a piece of cloth over the top. Place the jar in a pot half-full of boiling water, and keep the pot on the fire for four hours, simmering. Strain off the liquid essence through a coarse sieve; it will be about 5 or 6 ounces in quantity. One teaspoonful frequently, with or without wine or brandy, as may be ordered. A teaspoonful of cream may occasionally be added with advantage to 4 ounces of the essence, or it may be thickened with flour, arrowroot, or sago.

Essence of Beef (another Way Without Heat).

Half a pound of fresh beef cut up as finely as possible; to this add $^1/_2$ pint of pure, soft, cold water (rain-water is excellent, filtered, if necessary, from the nature of the vessels in which collected, as iron tanks, etc.); an eggspoonful of salt, and 5 drops of pure hydrochloric acid (spirit of salt). Mix and stir well, and after an hour filter through a conical sieve without pressure. The fluid must be returned into the sieve until it runs through clear. Next, another $^1/_2$ pint of cold, pure, soft water is to be poured on the meat in the sieve, and this is also to run through without pressure. The result will be about $^3/_4$ pint of a red solution of meat containing most of the al-

bumin, coloring and flavoring matters, salts, and other soluble materials. Half a wineglassful of this may be taken cold for a child twelve years old; a teaspoonful to a dessert or tablespoonful for younger children. Or it may be slightly warmed by standing in a jar immersed in hot—not boiling—water. It may be colored with burned sugar, if desirable. This is a veritable meat-essence, and is of use in extreme prostration, notably after burns, in continued fever, in some cases of dyspepsia, and in the diarrhœa of infants, as alluded to elsewhere.

Fresh Pabula.

These contain essentially the so-called antiscorbutic element, and may be given, not only to provide this unknown, but necessary, constituent of food, but also as additional nutrient agents. The chief articles are:—

Raw Meat-juice.—To prepare this take 2 ounces of gravy-beef, free from fat, and chop into small pieces; add to 2 ounces (4 tablespoonfuls) of water in a cup, and stand in a warm place for half an hour; then squeeze through muslin to express the juice. The temperature of the meat-juice must never be above lukewarm, or the soluble albuminoids will be coagulated and its value destroyed. Raw meat-juice will not keep for more than 10 or 12 hours, and should be made fresh whenever wanted.

Bananas. — Fresh ripe bananas, either grated or sieved, afford a valuable fruit-food. It has been found that these with milk will constitute a useful nourishing food for infants.

Egg-albumin.—Egg-albumin is prepared for use by stirring up the white of 1 new-laid egg with 4 ounces of water. Prepared thus and sweetened, it may take the place, for a time, of the ordinary milk diet in infantile

diarrhœa, after appropriate treatment with repeated small doses of calomel. Egg-albumin can hardly be considered as a substitute for raw meat-juice, which contains only about 3 per cent. of albumin (myosin), but which is a powerful digestive stimulant, owing to the presence of extractives (creatin, etc.).

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